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Amoni et al.

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[54] **SYSTEM AND METHOD FOR VOLTAGE SWITCHING TO SUPPLY VARIOUS VOLTAGES AND POWER LEVELS TO A PERIPHERAL DEVICE**

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[21] Appl. No.: **842,695**

[22] Filed: **Apr. 15, 1997**

[51] **Int. Cl.**[6] **G06F 1/26**

[52] **U.S. Cl.** **395/750.01**; 395/750.02; 364/492

[58] **Field of Search** 395/750.01, 750.03, 395/750.07, 750.06; 364/707, 492

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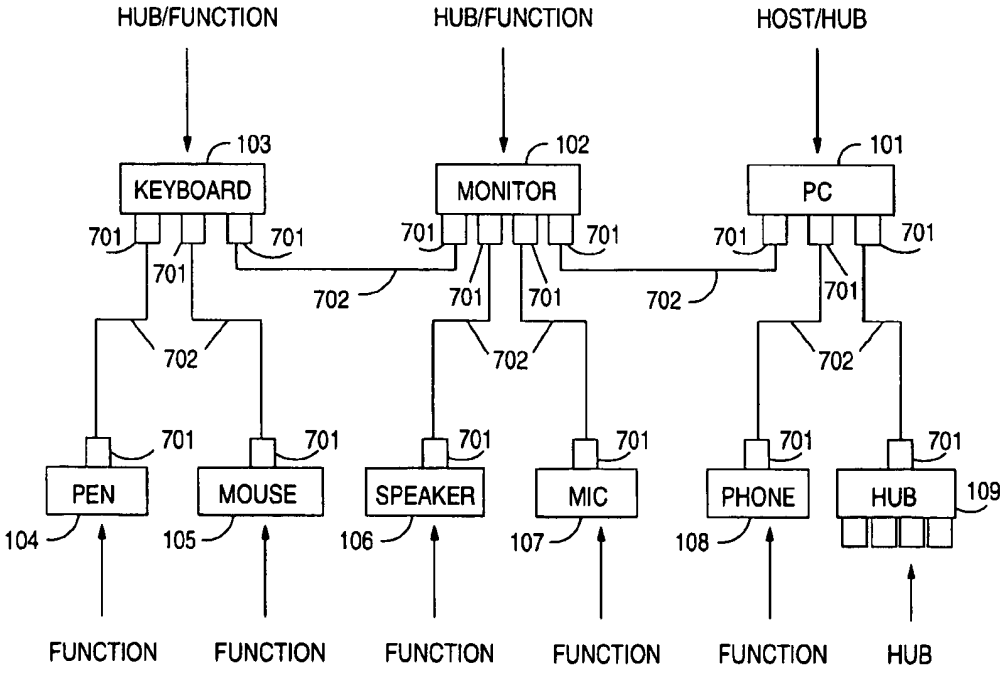
[57] **ABSTRACT**

Within a data processing system, such as a personal computer, non-standard, or auxiliary, voltage and current may be supplied to an attached peripheral device along with standard Universal Standard Bus (USB) power and signalling. A communication protocol is enabled between the host system and the peripheral device to permit the peripheral device to communicate its power requirements to the host device so that the host device can switch the proper voltage and current through the USB cable to the peripheral device. This allows the peripheral device to obtain power without having to connect to an AC power supply.

21 Claims, 9 Drawing Sheets



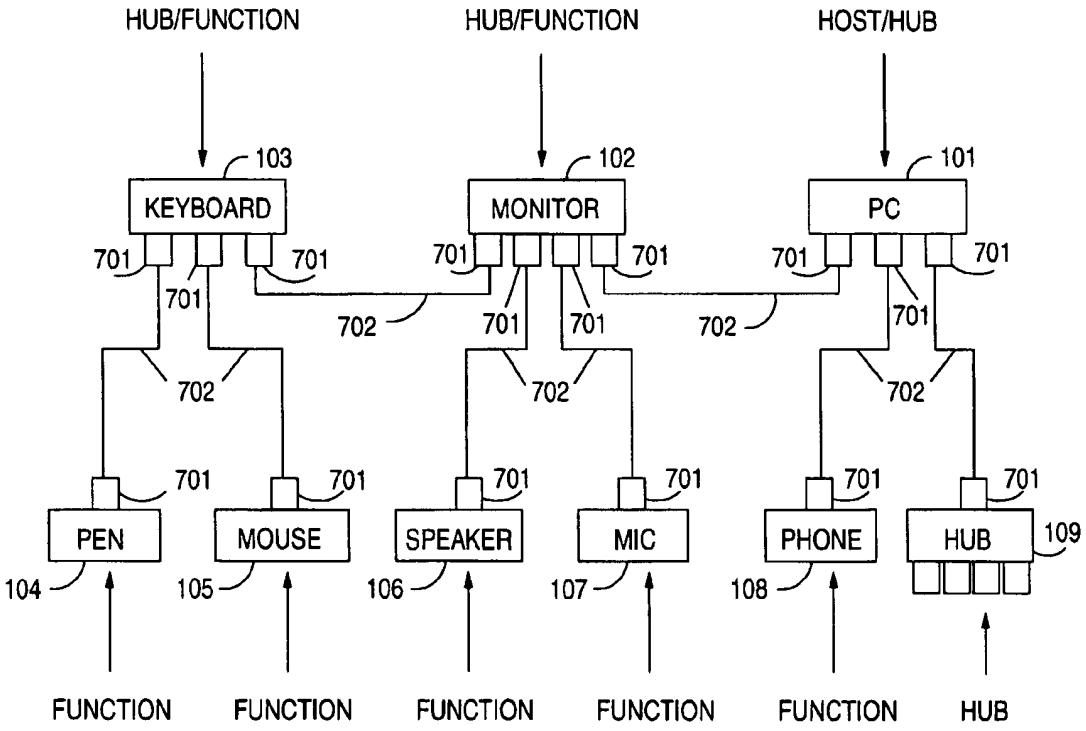

HUB/FUNCTION
HUB/FUNCTION
HOST/HUB
103
102
101
KEYBOARD
MONITOR
PC
701
702
PEN
MOUSE
SPEAKER
MIC
PHONE
HUB
109
104
105
106
107
108
FUNCTION
FUNCTION
FUNCTION
FUNCTION
FUNCTION
HUB

FIG. 1

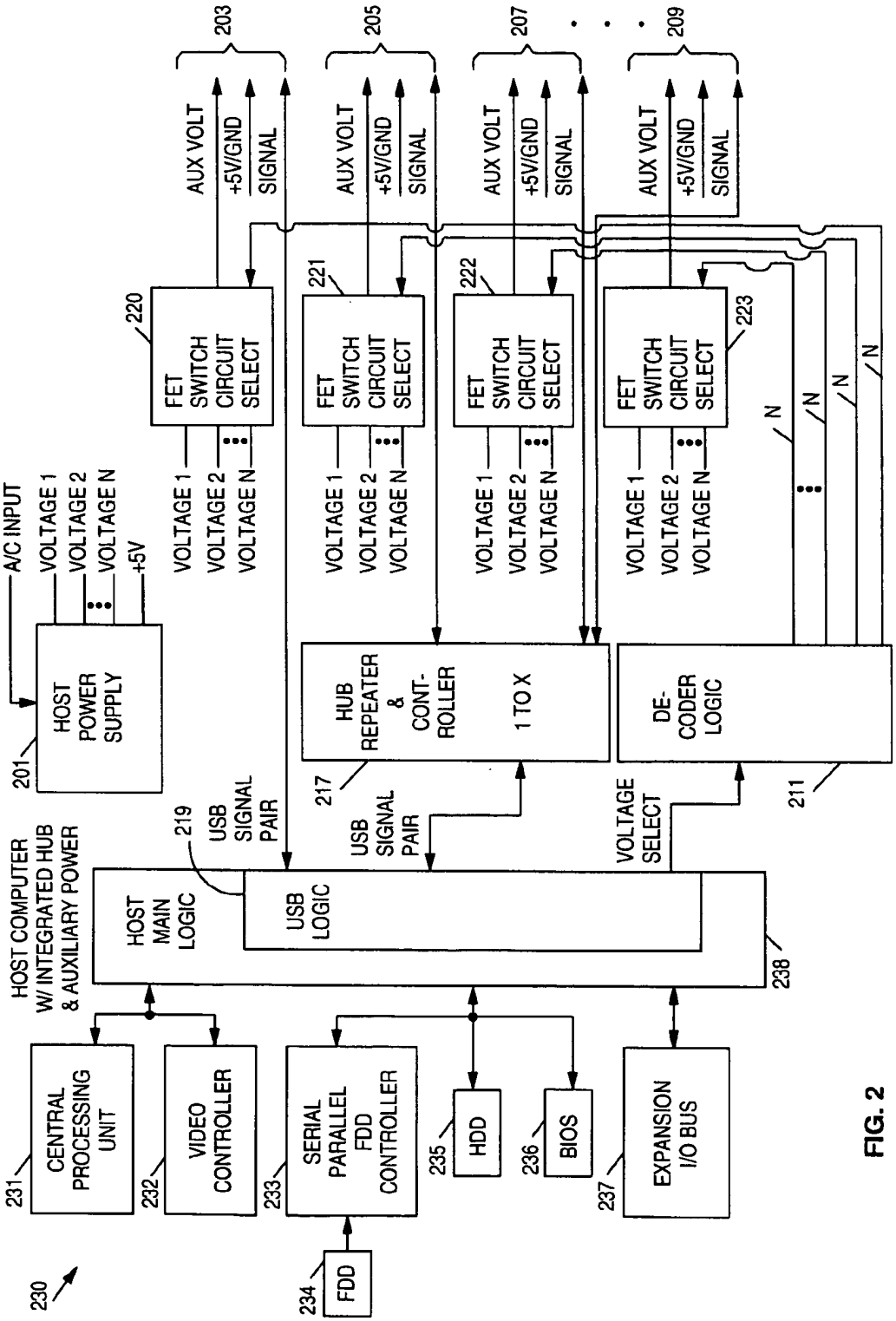

203
205
207
209
AUX VOLT
+5V/GND
SIGNAL
220
221
222
223
FET SWITCH CIRCUIT SELECT
VOLTAGE 1
VOLTAGE 2
VOLTAGE N
N
A/C INPUT
+5V
HOST POWER SUPPLY
201
HUB REPEATER & CONT-ROLLER 1 TO X
217
DE-CODER LOGIC
211
USB SIGNAL PAIR
219
VOLTAGE SELECT
HOST COMPUTER W/ INTEGRATED HUB & AUXILIARY POWER
HOST MAIN LOGIC
USB LOGIC
238
CENTRAL PROCESSING UNIT
231
VIDEO CONTROLLER
232
SERIAL PARALLEL FDD CONTROLLER
233
HDD
235
BIOS
236
EXPANSION I/O BUS
237
FDD
234
230

FIG. 2

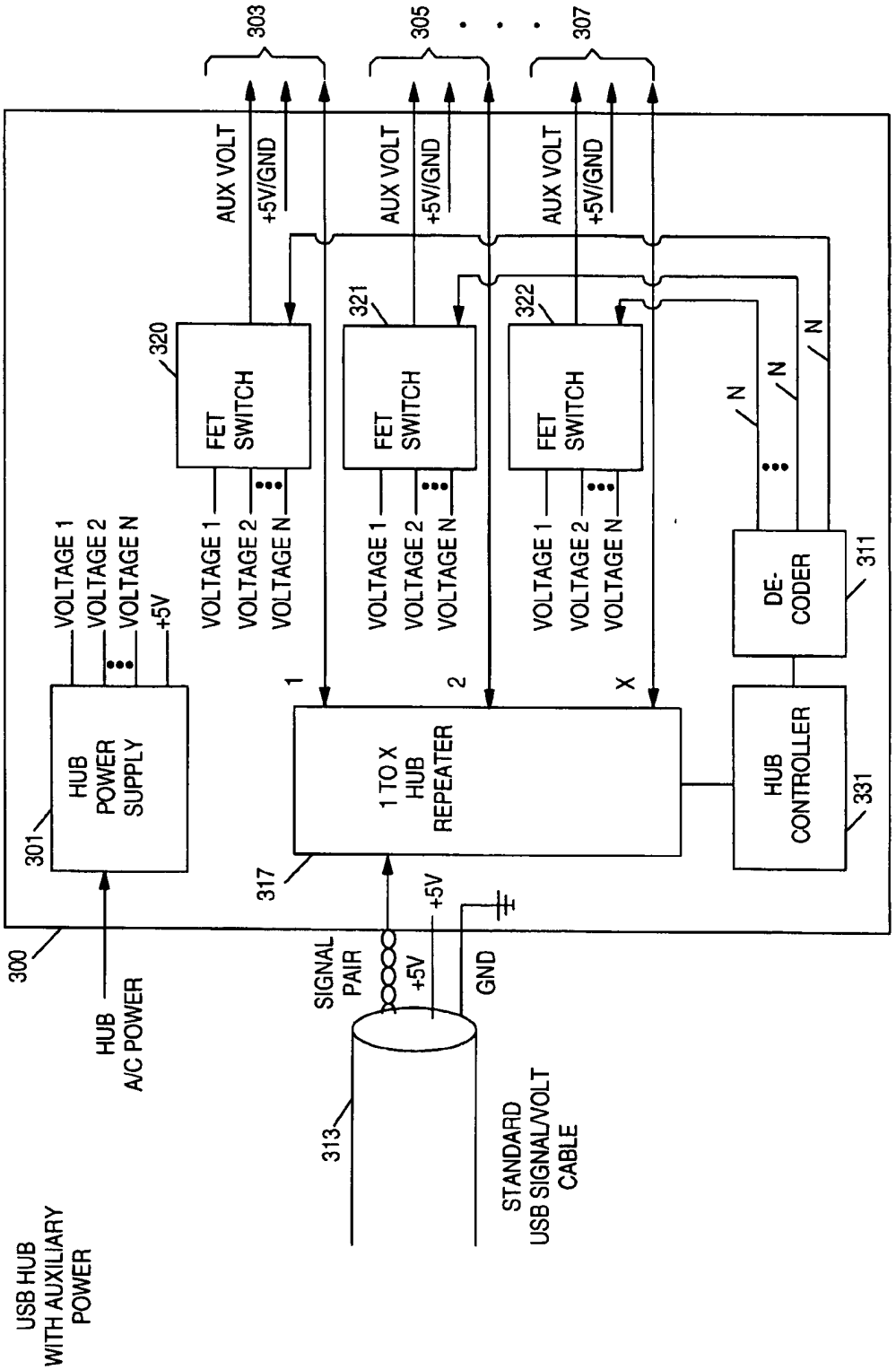

303
305
307
AUX VOLT
+5V/GND
320
321
322
FET SWITCH
VOLTAGE 1
VOLTAGE 2
VOLTAGE N
N
311
DE-CODER
HUB CONTROLLER
331
1 TO X HUB REPEATER
1
2
X
HUB POWER SUPPLY
301
+5V
317
300
HUB A/C POWER
SIGNAL PAIR
GND
313
STANDARD USB SIGNAL/VOLT CABLE
USB HUB WITH AUXILIARY POWER

FIG. 3

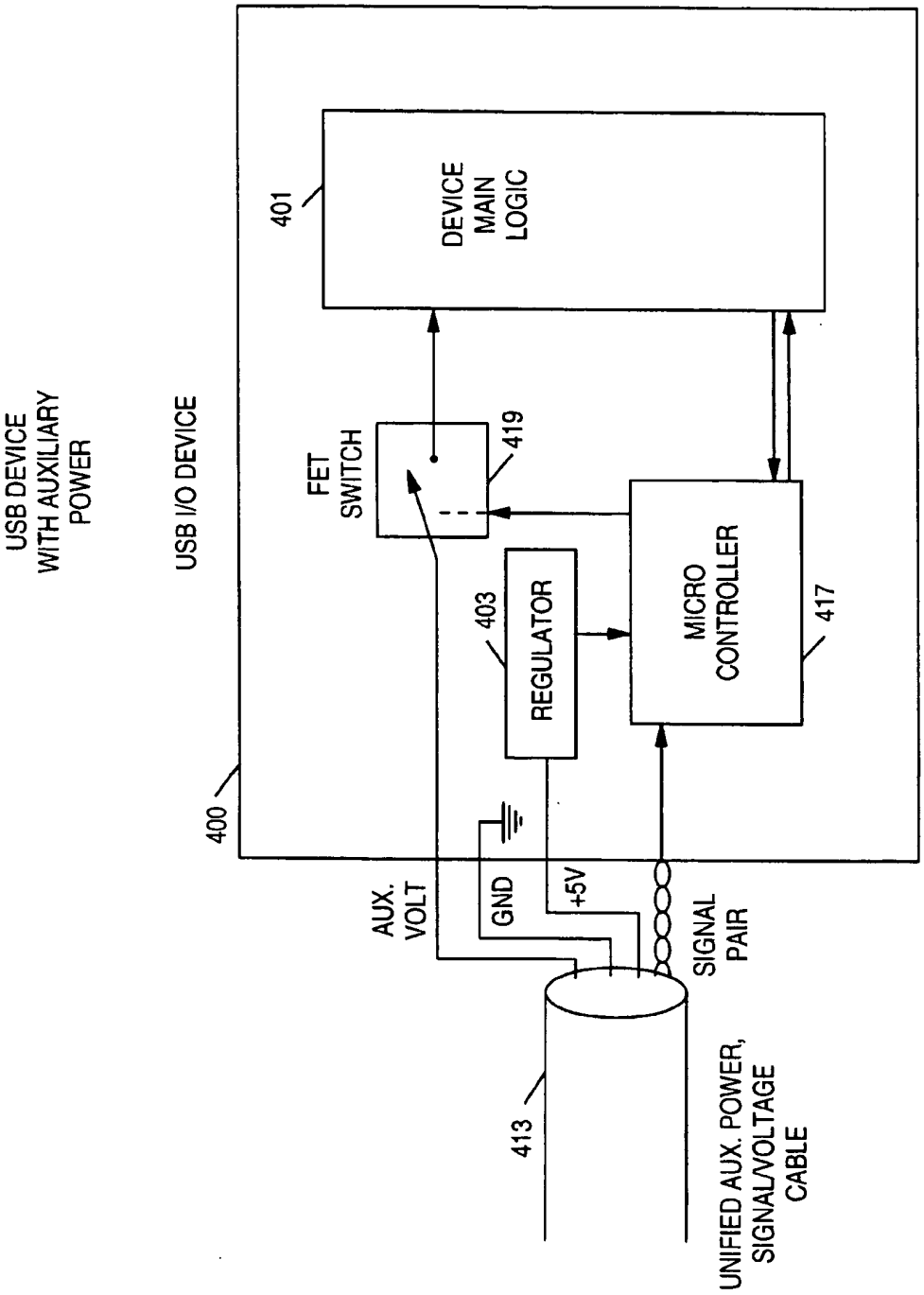

USB DEVICE WITH AUXILIARY POWER
USB I/O DEVICE
400
401
DEVICE MAIN LOGIC
FET SWITCH
419
403
REGULATOR
MICRO CONTROLLER
417
AUX. VOLT
GND
+5V
SIGNAL PAIR
413
UNIFIED AUX. POWER, SIGNAL/VOLTAGE CABLE

FIG. 4

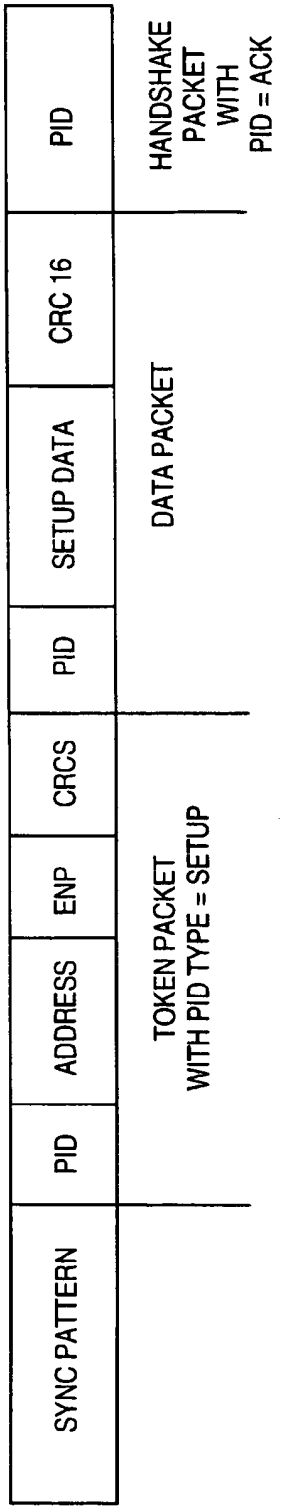

SYNC PATTERN
PID
ADDRESS
ENP
CRCS
TOKEN PACKET
WITH PID TYPE = SETUP
PID
SETUP DATA
CRC 16
DATA PACKET
PID
HANDSHAKE
PACKET
WITH
PID = ACK

FIG. 5

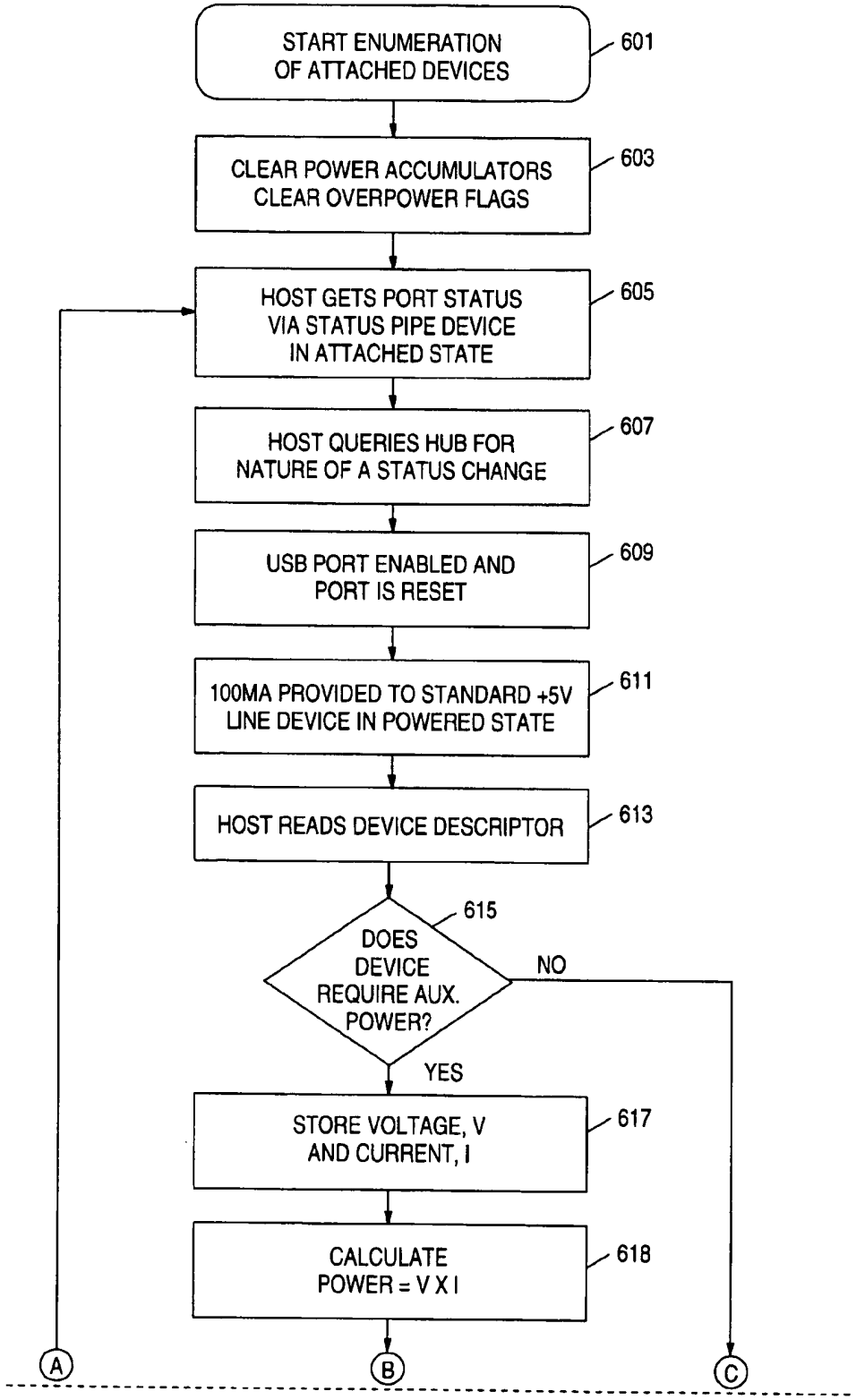

START ENUMERATION OF ATTACHED DEVICES
601
CLEAR POWER ACCUMULATORS CLEAR OVERPOWER FLAGS
603
HOST GETS PORT STATUS VIA STATUS PIPE DEVICE IN ATTACHED STATE
605
HOST QUERIES HUB FOR NATURE OF A STATUS CHANGE
607
USB PORT ENABLED AND PORT IS RESET
609
100MA PROVIDED TO STANDARD +5V LINE DEVICE IN POWERED STATE
611
HOST READS DEVICE DESCRIPTOR
613
615
DOES DEVICE REQUIRE AUX. POWER?
NO
YES
STORE VOLTAGE, V AND CURRENT, I
617
CALCULATE POWER = V X I
618
A
B
C

FIG. 6A

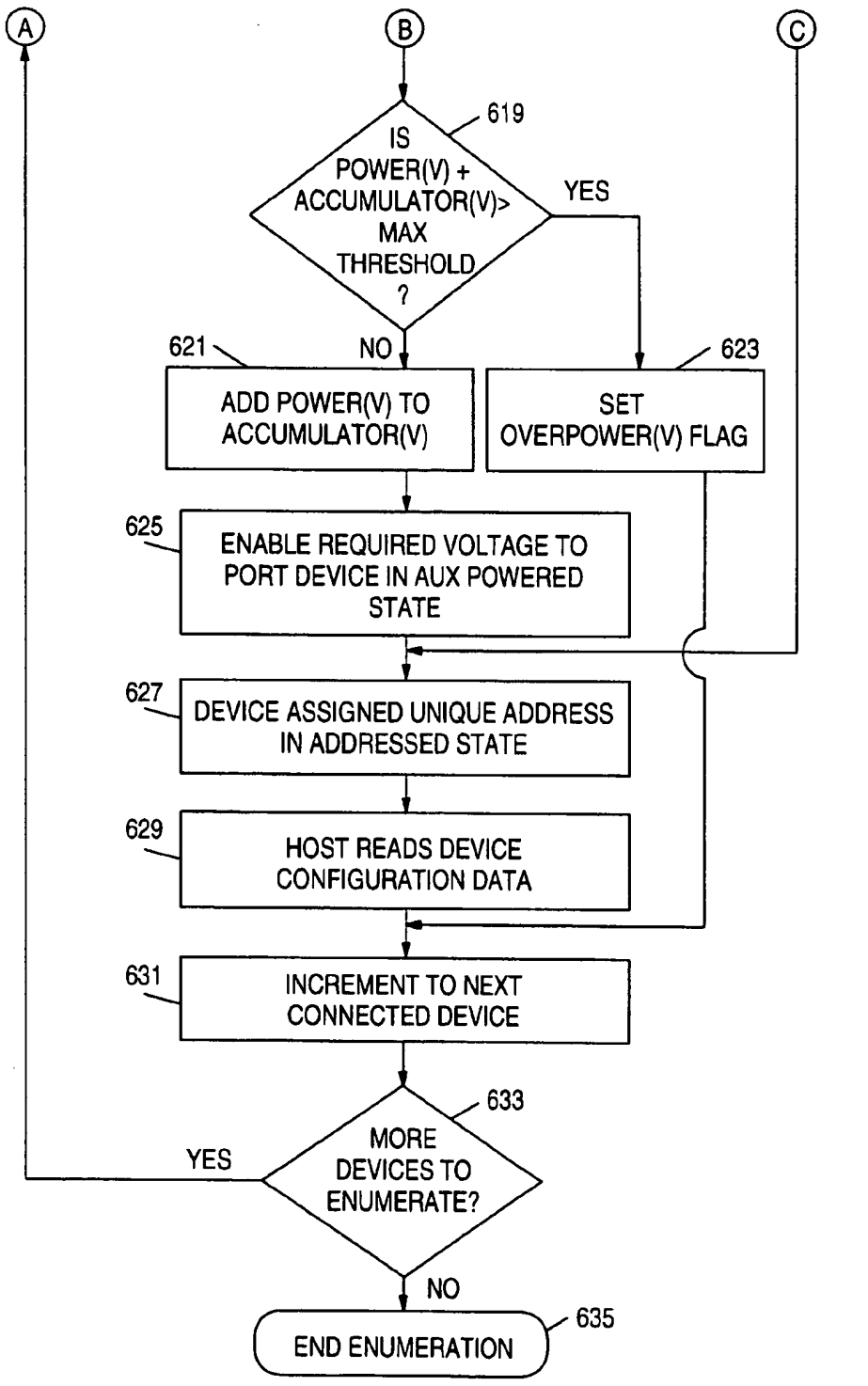

A
B
C
619
IS POWER(V) + ACCUMULATOR(V)> MAX THRESHOLD ?
YES
NO
621
ADD POWER(V) TO ACCUMULATOR(V)
623
SET OVERPOWER(V) FLAG
625
ENABLE REQUIRED VOLTAGE TO PORT DEVICE IN AUX POWERED STATE
627
DEVICE ASSIGNED UNIQUE ADDRESS IN ADDRESSED STATE
629
HOST READS DEVICE CONFIGURATION DATA
631
INCREMENT TO NEXT CONNECTED DEVICE
633
MORE DEVICES TO ENUMERATE?
YES
NO
635
END ENUMERATION

FIG. 6B

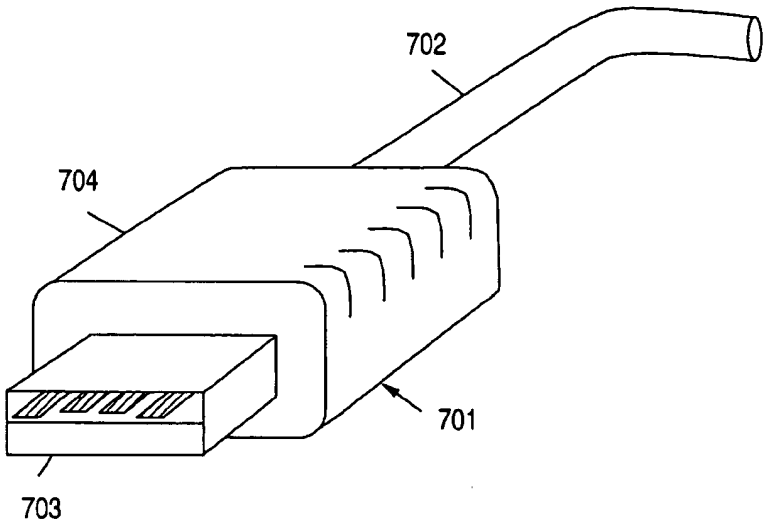


FIG. 7

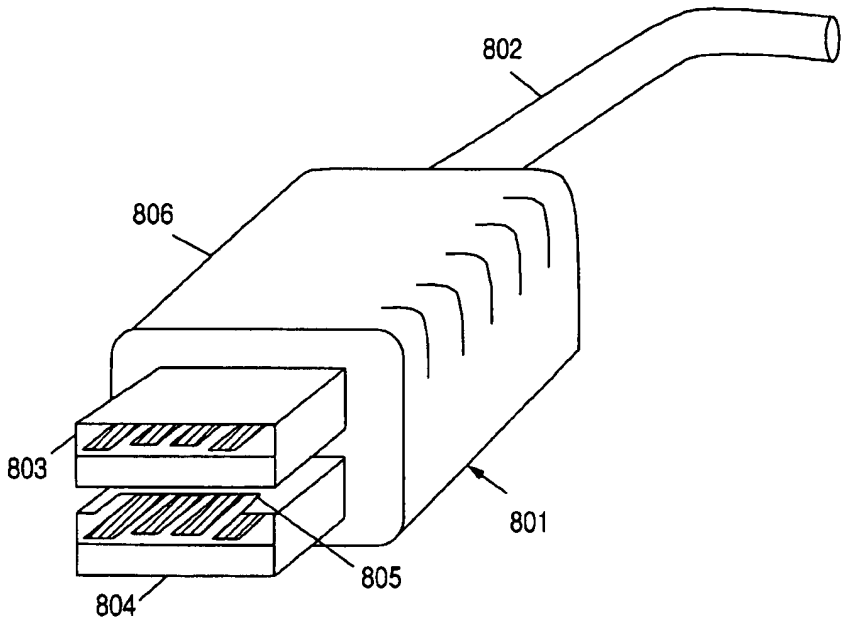


FIG. 8

SYSTEM AND METHOD FOR VOLTAGE SWITCHING TO SUPPLY VARIOUS VOLTAGES AND POWER LEVELS TO A PERIPHERAL DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application for patent is related to co-pending U.S. patent application Ser. No. 08/807,493, filed Feb. 27, 1997, entitled "ENHANCED UNIVERSAL SERIAL BUS," which is hereby incorporated by reference herein.

TECHNICAL FIELD

The present invention relates to supplying various voltages and power levels via a standard bus interface. More particularly, it relates to supplying multiple voltages via a Universal Serial Bus compatible interface.

BACKGROUND INFORMATION

Recently, personal computers ("PCs") used a variety of techniques for providing input and output. These included a serial port, usually an RS232, a parallel port and several ISA expansion slots included on the mother board. Connecting the PCs to anything more complicated than a mouse, modem or printer required the lid to be taken off and dip switches to be set and software configured. SCSI (small computer systems interface) permitted access to external storage devices, but required a large cable connector with the need to manually set ID numbers and have a terminator.

The universal serial bus ("USB") is specified to be an industry standard extension to the PC architecture with a focus on computer telephony interface, consumer and productivity applications. The USB architecture provides for ease of use of peripheral expansion, transfer rates up to 12 megabits per second, protocol flexibility for mixed modes, isochronous data transfers, and asynchronous messaging. USB is a cable bus supporting data transfer between the host PC and a range of simultaneously testable peripherals. One host controller can support up to 127 physical devices using a tiered topology. The hub is at the center of each star with each wire segment creating a point-to-point connection of up to 5 meters. The 5 meter limitation may be between a host and a hub or a hub function or a hub connected to another hub or function.

Alternatively, a number of peripherals can be daisy chained together through compound hubs via the 4-wire USB cable. One of the 4 wires referred to as VBUS provides a DC voltage of +5 volts and another wire provides a ground signal. The USB cable provides power to the devices along the chain. Signaling takes place over two wires between two end points. The signals of each end point are driven differentially over a 90 ohm impedance with each receiver featuring input sensitivity of at least 200 millivolts. A non-return to zero invert (NRZI) with bit stuffing to insure adequate transitions is used to carry the bus clock down the chain. A sync field precedes each data package to allow the receivers to synchronize their bit recovery clocks. The serial interface provides a bandwidth of 12 megabits per second and can connect as many as 127 devices to a host system.

USB relies on a tiered star topology. Physically USB devices ranging from a mouse or joystick to telephones connect to a host via layers of multiport hubs. The requisite hub called "the root hub" is located in the host and can include multiple ports. Hubs are linked to USB devices via point-to-point connections. The host views all USB devices as if they connect in a true star arrangement. USB supports both the standard devices that operate a full 12 megabit rate and low end devices that use only a 1.5 megabit sub-channel. Hubs support 12 megabit operations and insure that 12 megabit transmissions do not go to 1.5 megabit devices.

USB cables that carry 12 megabit traffic require a shielded twisted pair construction on the signal pair and can be no longer than 5 meters. Low speed cables can be no longer than 3 meters and require no shielding or twisting of the signaling pair. The host uses a master slave protocol to control the bidirectional communications with USB devices. The interface employs a 1 KHZ bus clock that instigates bussing a new frame every 1 millisecond. The interface handles multiple transactions including time critical isochronous transactions within each frame in 1 millisecond periods and 12 megabit per second bandwidth limits the type of isochronous data streams that the interface can successfully carry.

One problem with the universal serial bus is that it provides only one voltage. Devices that operate at different voltages or have high power requirements are required to supply their own voltage sources and power sources. In some environments, for instance, the retail point-of-sale environment, this additional cabling for power creates a non-aesthetic appearance at the store front.

These unresolved problems and deficiencies are clearly felt in the art and are solved by the invention in the manner described below.

SUMMARY OF THE INVENTION

The foregoing need is addressed by the present invention which provides for the communication of auxiliary (non-standard USB) voltage and current to downstream hub and peripheral devices in accordance with the needs of the downstream hub and/or peripheral devices. This is performed over an enhanced USB connection, whereby standard USB signalling is provided along with the auxiliary power.

Communication of auxiliary power requirements is provided from the peripheral device to the upstream hub or host, which then utilizes one or more switches to connect the auxiliary power to the port coupled to the downstream hub/peripheral device.

The foregoing has outlined rather broadly the features and technical advantages of the present invention in order that the detailed description of the invention that follows may be better understood. Additional features and advantages of the invention will be described hereinafter which form the subject of the claims of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

FIG. **1** illustrates a data processing system configured in accordance with the present invention;

FIG. **2** illustrates a host computer with integrated hub and auxiliary power;

FIG. **3** illustrates a hub with auxiliary power capabilities;

FIG. **4** illustrates a peripheral device with auxiliary power;

FIG. **5** illustrates a communication protocol for communicating auxiliary power requirements to the host from a peripheral device;

FIG. 6 illustrates with FIGS. 6A and 6B a enumeration process for determining the auxiliary power requirements of peripheral devices;

FIG. 7 illustrates a standard USB plug; and

FIG. 8 illustrates a non-standard USB plug.

DETAILED DESCRIPTION

In the following description, numerous specific details are set forth such as specific voltages and currents to provide a thorough understanding of the present invention. However, it will be obvious to those skilled in the art that the present invention may be practiced without such specific details. In other instances, well-known circuits have been shown in block diagram form in order not to obscure the present invention in unnecessary detail. For the most part, details concerning timing considerations and the like have been omitted inasmuch as such details are not necessary to obtain a complete understanding of the present invention and are within the skills of persons of ordinary skill in the relevant art.

Refer now to the drawings wherein depicted elements are not necessarily shown to scale and wherein like or similar elements are designated by the same reference numeral through the several views.

Within the following description, a standard universal serial bus connector, receptacle, plug, and signalling all refer to the USB architecture described within the "*Universal Serial Bus Specification*," 1.0 Final Draft Revision, Copyright Nov. 13, 1995, which is hereby incorporated by reference herein. While an embodiment of the invention will be illustrated using the Universal Serial Bus, it is not limited to the USB.

Referring to FIG. **1**, there is illustrated a diagram of how hubs provide connectivity in a desktop computer environment. The data processing system shown in FIG. **1** includes computer (PC) **101**, monitor **102**, and keyboard **103**. Coupled to PC **101** are phone **108** and another hub **109**. Coupled to monitor **102** are speaker **106** and microphone (MIC) **107**. Coupled to keyboard **103** are pen **104** and mouse **105**. PC **101** is coupled to monitor **102**, which is coupled to keyboard **103**. Coupling is via USB buses **702** with USB plug connectors **701** (see FIG. **7**).

A function is a USB device that is able to transmit or receive data or control information over the bus. A function is typically implemented as a separate peripheral device with a cable that plugs into a port on a hub. However, a physical package may implement multiple functions and an embedded hub with a single USB cable. This is known as a compound device. A compound device appears to the host as a hub with one or more permanently attached USB devices.

Each function contains configuration information that describes its capabilities and resource requirements. Before a function can be used, it must be configured by the host. This configuration includes allocating USB bandwidth and selecting function specific configuration options.

Referring next to FIG. **7**, there is illustrated standard USB cable plug **701** having bus **702** coupled thereto. Plug **701** includes a standard USB shielded plug housing **703**, which conforms to the standard USB architecture described in the Universal Serial Bus specification referenced above. Standard USB shielded plug housing **703** operates to communicate differentially driven data signals D+ and D−, a 5-volt signal, and a ground signal.

Some or all portions of the topology shown in FIG. 1 may use a modified (enhanced) USB cable having an extra conductor to supply the extra voltage. Of course other voltages could be added so that a single cable may supply three or more voltages with the addition of other conductors or wires. For purposes of clarity of understanding, the present invention will be described with respect to two conductor types in the cable. Cables with at least one other conductor (i.e., for instance 5 wire) are referred to as auxiliary (or non-standard) cables in that they supply or are capable of supplying auxiliary power. The auxiliary cables are designed to operate seamless with non-auxiliary powered devices.

In other words, some of cables **702** and corresponding connectors **701** illustrated in FIG. **1** may implement non-standard USB, or auxiliary, configurations for providing other than standard USB voltages to hubs or peripherals.

Referring next to FIG. **8**, there is illustrated auxiliary plug **801**, which further includes a non-standard USB portion **804**, which may communicate non-standard USB power transmission, such as auxiliary voltage signals and corresponding ground signals. Plug **801** has overmold **806** corresponding to overmold **704**, standard USB portion (plug housing) **803** corresponding to shielded standard portion (plug housing) **703**, and bus **802** corresponding to bus **702**, except that additional hardware and parts have been added to implement non-standard USB portion **804**. Housing **804** may include a housing having cut-out portion **805**, which enables housing **804** to mate with a non-standard USB receptacle through specifically designed chassis cut-outs. Please refer to cross-referenced patent application Ser. No. 08/807,493, filed Feb. 27, 1997 for a further discussion of such chassis cut-outs and non-standard plug **801**.

Using the auxiliary cable, peripheral devices can be supplied power at two or more distinct voltages: the standard USB voltage of +5 and one or more other voltages. The voltage and power requirements for the auxiliary power can be negotiated with the host or hub. The auxiliary powered USB hub or function uses the standard USB communications and standard USB power to request a second voltage and power.

Auxiliary Host Device

FIG. **2** illustrates a host device **230** with multiple auxiliary USB ports **203, 205, 207, 209**. The host device **230** could be the same as host/hub **101** illustrated in FIG. **1**. The host device **230** may include central processing unit **231**, video controller **232**, serial parallel floppy disk drive controller **233**, floppy disk drive **234**, hard disk drive **235**, bios **236**, expansion I/O bus **237**, and host main logic **238**. Naturally, host **230** may include other well-known data processing system elements. Note that a standard USB device can use an auxiliary USB port by using a standard USB cable.

The power supply **201** takes AC input and provides a plurality of DC voltages, including the USB standard voltage +5 volts. Other voltages may include +12, −12, +24, −24, or −3 volts. Any suitable voltages may be selected. The non-standard voltages are supplied by conductors (not shown) to switch circuits **220–223** provided for each of the ports **203, 205, 207, 209**, respectively. In addition to the standard +5 volts, each port **203, 205, 207, 209** shown in FIG. **2** is capable of providing an auxiliary voltage from one of the many voltages output by the power supply **201**. The host **230** can select which ports are provided with which auxiliary voltages using the decoder **211**. The decoder **211** can direct each of the switches **220–223** to select the appropriate voltage for each of the ports **203, 205, 207, 209** as requested by the auxiliary peripheral device.

A 1toX hub repeater and controller **217** provides for data communications from the host **230** to the peripherals and

hubs (see FIG. **1**) and also provides the host **230** with data communications from the peripherals and hubs. The USB host/hub **230** is generally a Very Large Scale Integrated (VLSI) state machine which is controlled by the host CPU **231**. The Auxiliary USB logic is shown in function block **219**. The USB logic **219** handles standard USB functions as well as auxiliary power requests.

Auxiliary Hub

FIG. **3** illustrates a functional block diagram of an auxiliary hub **300** which could be keyboard **103** or monitor **102**. The auxiliary hub **300** provides for three auxiliary powered USB ports **303, 305** and **307** although more could be added. Each of the ports **303, 305, 307** provide a standard USB port with the additional auxiliary voltage. The auxiliary hub **300** is connected to the host **230** (see FIG. **1**) via standard USB cable **313**. Although discussed as connecting to the host/hub **230**, cable **313** may connect to another hub (not shown), which may be connected to another hub (not shown) eventually reaching the host/hub **230**.

The auxiliary hub **300** contains its own AC/DC power supply **301**, which is capable of outputting at least one voltage other than 5 volts (i.e., at least one auxiliary voltage) and can produce a plurality of voltages including the USB standard +5 volts. The USB standard voltage may be supplied to the auxiliary ports **303, 305** and **307** from the host **230** via the host-to-hub cable **313** rather than from the power supply **301**.

The non-USB standard voltages are supplied by conductors (not shown) to switch circuits **320–322**. Switch circuits **320–322** are associated with each of the ports **303, 305** and **307**. In addition to the standard +5 volts, each port **303, 305, 307** is capable of providing an auxiliary voltage from one of the many voltages output by the power supply **301**.

The hub **300** can select which ports are provided with which auxiliary voltages, if any, using the decoder **311**. The decoder **311** can direct each of the switches **320–322** to select the appropriate voltage for each of the ports **303, 305, 307**, respectively, as requested by the auxiliary peripheral device.

The hub controller **331** is coupled to the decoder **311** and 1toX hub repeater **317**. The repeater **317** makes sure (1) data sent from cable **313** makes its way to the addressed peripheral, and (2) data flowing upstream makes it way to the host **230**.

Use of the power supply **301** in the hub **300** requires that A/C power be supplied to the hub **300**. This entails use of a power cord and access to A/C outlet. Normally this would be an AC outlet on the host computer. Use of the power cord can be eliminated by using upstream auxiliary power in a DC—DC converter if a different voltage is required by the peripheral devices. The power available to downstream devices would be limited, since total power received from the upstream auxiliary power source is divided among the downstream devices.

In FIG. **3**, this would be implemented by replacing standard USB cable **313** with an enhanced USB cable with auxiliary power conductors, as is disclosed herein. The auxiliary power conductors would flow to downstream ports. Note, however, that the downstream ports would then no longer be able to request any type of auxiliary voltage. An allowance would need to be made for hub **300** to request a specific auxiliary voltage from the upstream host (e.g., the highest available voltage from the host). Then, during the auxiliary power request phase of step **615** in FIG. **6A**, host software could request downstream devices to resubmit their request based on available voltage. A device could then signal a new power request or that it does not have DC—DC capability and cannot be configured, or the host could determine that the request exceeds the host power supply capacity and not configure the device.

The implications to the upstream power management is that the upstream power management for the auxiliary power is dictated by the host computer power management protocol. Auxiliary power should be viewed as the device's "local power supply" for power management purposes. Please refer to section 7.2.1.2 on "Self-Powered Hubs," and section 4.3.2 on "Power Management" within the Universal Serial Bus Specification referenced above.

Peripheral Devices

FIG. **4** illustrates a peripheral device **400** that can make use of auxiliary power. The auxiliary peripheral **400** is coupled to the auxiliary cable **413** as shown. The auxiliary cable **413** may be coupled to host **230**, or hub **300**. The auxiliary peripheral device ("APD") **400** makes use of standard USB signals to request auxiliary power. Thus, when the cable **413** is hot plugged, USB standard power signals (+5 volts) provide power to the microcontroller **417** via regulator **403**. The microcontroller **417** then can request an auxiliary voltage and power allocation using standard USB communications described below. As shown in FIG. **4**, the APD **400** may include a switch **419** under control of the microcontroller **417**. The switch **419** can prevent damage to the APD **400** by not permitting a connection from the auxiliary voltage line to the peripheral device's main logic **401** until the microcontroller **417** has received input from the auxiliary host **230** or hub **300** that its auxiliary power request can be granted.

Auxiliary Power Communication Protocol

The auxiliary USB peripheral **400** makes use of an auxiliary power enumeration process that uses native USB power and communications. The USB communication protocol uses four types of transactions: Control, Bulk, Interrupt and Isochronous. The Control transaction is used during device enumeration to communicate device configuration information to the host. This is done in two stages: Setup and Status. The Setup stage contains three packets: Token, Data and Handshake. The Setup stage serial bit stream showing the three packets is illustrated in FIG. **5**. The Data packet is formatted as shown in Table 1.

TABLE I

FIELD DESCRIPTION	BYTES
Request Type	1
Request	1
Value	2
Index	2
Length	2

The APD **400** can communicate its auxiliary power requirements in several ways. The first makes use of device descriptor data field as shown in Table II. The device descriptor data structure is returned to a host in response to a GET_DESCRIPTOR request type and has the following format:

TABLE II

FIELD DESCRIPTION	BYTES
Length of Descriptor	1
Descriptor Type	1
USB Specification Number	2

TABLE II-continued

FIELD DESCRIPTION	BYTES
Device Class(vendor specific type =0xFF)	1
Device Sub-Class	1
Device Protocol	1
Max Packet Size	1
Vendor ID	2
Product ID	2
Device Release Number	2
Manufacturer ID String Index	1
Product ID String Index	1
Serial Number Index	1
Number of Configurations	1

One way of transferring auxiliary power requirements from the device is to assign a vendor specific Device Class (0xFF) and designate a unique device sub-class assignment with unique encoded voltage and power requirements. Using a single byte: two bits (V2, V1) could be allocated to voltage selection with the remaining six bits (C6,C5,C4,C3,C2,C1) allocated to current requirements. For current, one of 64 different levels could be specified or a fixed increment could be allocated such as 50 ma with bits C1–C6 indicating in binary the number of increments. A fixed current increment eliminates the need for a look-up table in the ADP.

A second way for the APD **400** to specify power requirements is to use a Product String Index pointing to a string containing voltage and current requirements. This string may be text format and include a voltage request (ie., "12V") and a current request (i.e., "800 ma"). The index to a product string is contained in the Device Descriptor at offset 15 (see section 9.6.1 of the Universal Serial Bus Specification referenced above). The index points to the location of a text string in UNICODE format (see section 9.6.5 of the Universal Serial Bus Specification).

A third way of encoding the auxiliary power requirements is to use an iConfiguration Index located in the Configuration Descriptor. This may also be specified in text format. The index to a configuration is located in the Configuration Descriptor at offset 6 (see section 9.6.2 of the Universal Serial Bus Specification) and points to the location of a text string of UNICODE format (see section 9.6.5 of the Universal Serial Bus Specification).

Referring next to FIG. **6**, which comprises FIGS. **6A** and **6B**, there is illustrated a flow diagram illustrating a process, which may be implemented within USB logic **219** and/or within hub **300** for responding to request for auxiliary power from peripheral device **400**. The process begins at step **601**, wherein enumeration of all attached devices is begun. For example, one or more peripheral devices **400** may be coupled to ports **203**, **205**, **207** and/or **209**, or to ports **303**, **305** and/or **307**.

In step **603**, power accumulators are cleared and overpower flags are cleared. The power accumulator is a mathematical variable stored in a specific host memory location. Its purpose is to store a running total of supplied auxiliary power from the host A/C power supply. This variable is tested against the known maximum available power from the host power supply to prevent a host overpower condition.

The subscript "v" indicates that there could be a separate power accumulator for each different voltage line. Power supplies generally limit maximum power on each voltage line, as well as an overall maximum power.

The overpower flags are also variables and are used to store the condition that the host power supply cannot supply additional auxiliary power. There may be a separate overpower flag for each auxiliary voltage (i.e., +12v, +24v, etc.). Thereafter, in step **605**, the host/hub obtains port status via status pipe. Device is now in attached state. When a hub detects that a USB cable has been plugged into one of its downstream ports, it signals to host software that a change has occurred through Port Commands. An expanded diagram of detecting a port status changed is shown in section 11.8.2 of the Universal Serial Bus Specification. This is part of the standard USB Bus Enumeration and a summary of this is shown in section 9.1.2 of the Universal Serial Bus Specification. A general description of USB device states when first plugged in is given in the first several pages of chapter 9 of the Universal Serial Bus Specification. Thereafter, in step **607**, the host/hub queries the downstream hub/peripheral for the nature of a status change. Additional Port Commands are used by host software to determine what type of change occurred at the hub's downstream port, such as an Attach or Detach, etc.

Next, in step **609**, the port is enabled and is reset. In step **611**, standard USB power is supplied (100 milliamps provided to a standard +5 volt line) to the device through the port and USB line. Next, in step **613**, the host/hub reads the Device Descriptor, which is supplied by the downstream hub/peripheral device. In step **615**, a determination by above-mentioned methods is made whether or not the hub/peripheral device requires any auxiliary power. If not, the process proceeds to step **627**. However, if the device does require auxiliary power, then the process proceeds to step **617** to store the voltage and current requirements of the hub/peripheral device. In step **618**, the power is computed.

Thereafter, in step **619**, a determination is made whether or not the power calculated in step **618** plus any power calculated in an accumulator value with respect to any other devices attached to ports is greater than the maximum threshold of the host/hub. If yes, then in step **623**, an overpower flag is set and the process proceeds to step **631**.

In step **621**, the calculated power from step **618** is added to the accumulator value. In step **625**, the voltage required by the hub/peripheral device is enabled via the auxiliary voltage line. In step **627**, the hub/peripheral device is assigned a unique address. Device is now in the Address State. Devices must have a unique address with which they can be identified by the host software. Initially all devices have the same default address, but are addressed in a sequential manner during Bus Enumeration, which allows a single device to respond at any one time to host software requests. As part of Bus Enumeration, unique addresses are assigned to each device so host software can communicate with the devices in a random manner. Please refer to section 9.1.1.4 of the Universal Serial Bus Specification for further discussion on this aspect. In step **629**, the host/hub reads the device configuration data. The Configuration phase of Bus Enumeration is required by host software to request specific information from the device before its function can be used (please refer to section 9.2.3 of the Universal Serial Bus Specification). Thereafter, in step **631**, the logic increments to enumerate the next device.

In step **633**, a determination is made whether or not there are any more hub/peripheral devices to enumerate. If yes, the process proceeds to step **605**. However, if there are no more hub/peripheral devices, then the process ends the enumeration process at step **635**.

This process helps ensure that an operating computer does not encounter an over-power condition and shut down during critical applications. The device is simply denied power and not configured when attached. This provides data integrity and avoids system crashes in a plug-n-play environment.

While the invention has been described in detail herein in accord with certain embodiments thereof, modifications and changes therein may be effected by those skilled in the art. Accordingly, it is intended by the appended claims to cover all such modifications and changes as fall within the true spirit and scope of the invention.

What is claimed is:

1. A host device comprising:

circuitry operable for receiving a request, from a peripheral device coupled to said host device, for a first power-related signal, wherein said host device is a computer system including at least one processor;

circuitry operable for sending said first power-related signal from said host device to said peripheral device in response to said request;

a power supply operable for providing said first power-related signal; and

a first switch operable for (1) receiving said first power-related signal from said power supply, and (2) switching said first power-related signal to be sent to a first port coupled to said peripheral device in response to decoder logic coupled to said receiving circuitry.

2. The host device as recited in claim 1, wherein said request is for a specified voltage and/or current signal.

3. A host device comprising:

circuitry operable for receiving a request, from a peripheral device coupled to said host device, for a first power-related signal;

circuitry operable for sending said first power-related signal from said host device to said peripheral device in response to said request,

wherein said peripheral device is coupled to said host device via an enhanced standard universal serial bus ("USB") interface, which includes a USB voltage signal and a standard USB communications link,

wherein said peripheral device communicates said request to said host device via said link, and

wherein said first power-related signal is a non-standard USB power signal.

4. A peripheral device, comprising:

circuitry adapatable for coupling to a bus having a data communications link and transmission lines operable for carrying first and second power-related signals;

circuitry powered by said first power-related signal and operable for sending via said data communications link a request for said second power-related signal; and

circuitry operable for receiving said second power-related signal from said bus.

5. The peripheral device as recited in claim 4, wherein said receiving circuitry further comprises a switch controllable by said sending circuitry for switching said second power-related signal to said peripheral device.

6. The peripheral device as recited in claim 5, wherein said sending circuitry is a microcontroller or a hardwired state machine coupled to said link and to said switch.

7. The peripheral device as recited in claim 4, wherein said first power-related signal and said data communications link are standard standard universal serial bus ("USB") signals, and wherein said second power-related signal is a non-standard USB signal.

8. The peripheral device as recited in claim 4, wherein said device receives all of its externally provided power from said first and second power-related signals.

9. In a data processing system, a method for providing auxiliary power from an upstream device to a downstream device, said method comprising the steps of:

coupling said upstream device to said downstream device via a bus having a data communications link operable for transferring data communications and first and second power-related signals between said upstream device and said downstream device;

transferring said first power-related signal from said upstream device to said downstream device, said downstream device initially powered by said first power-related signal;

transferring, via said data communications link, from said downstream device to said upstream device a request for said second power-related signal; and

transferring from said upstream device to said downstream device said second power-related signal in response to said request.

10. The method as recited in claim 9, wherein said bus is an enhanced standard universal serial bus ("USB"), wherein said first power-related signal is a standard USB signal, and wherein said second power-related signal is a non-standard USB signal.

11. The method as recited in claim 9, further comprising the steps of:

coupling said upstream device to another downstream device via another bus having a data communications link operable for transferring data communications and third and fourth power-related signals between said upstream device and said another downstream device;

transferring said third power-related signal from said upstream device to said another downstream device, said another downstream device initially powered by said third power-related signal;

transferring, via said data communications link, from said another downstream device to said upstream device a request for said fourth power-related signal; and

transferring from said upstream device to said another downstream device said fourth power-related signal in response to said request.

12. The method as recited in claim 9, wherein said upstream device is a host computer and said downstream device is a peripheral device.

13. The method as recited in claim 9, wherein said upstream device is a hub device and said downstream device is a peripheral device, wherein said hub device is coupling said peripheral device to a host computer.

14. The method as recited in claim 9, wherein said request specifies a voltage and a current level for said second power-related signal.

15. The method as recited in claim 14, further comprising the step of:

switching said specified voltage and current levels from a plurality of possible voltage and current levels provided by a power supply in said upstream device to a port coupled to said bus.

16. A data processing system comprising:

a host computer having at least one processor;

a peripheral device coupled to said host computer via a bus having a data communications link operable for transferring data communications and first and second power-related signals between said host computer device and said peripheral device;

circuitry for transferring said first power-related signal from said host computer device to said peripheral device, said peripheral device initially powered by said first power-related signal;

circuitry for transferring, via said data communications link, from said peripheral device to said host computer device a request for said second power-related signal; and

circuitry for transferring from said host computer device to said peripheral device said second power-related signal in response to said request.

17. The system as recited in claim **16**, wherein said bus is an enhanced standard universal serial bus ("USB"), wherein said first power-related signal is a standard USB signal, and wherein said second power-related signal is a non-standard USB signal.

18. The system as recited in claim **16**, wherein said request specifies a voltage and a current level for said second power-related signal, further comprising the step of:

switching said specified voltage and current levels from a plurality of possible voltage and current levels provided by a power supply in said host computer to a port coupled to said bus.

19. The system as recited in claim **16**, further comprising:

circuitry for not transferring from said host computer device to said peripheral device said second power-related signal if to do so would exceed a power threshold in said host computer device.

20. The system as recited in claim **16**, wherein said peripheral device is a plug-n-play device with respect to said host computer device.

21. A host device comprising:

circuitry operable for receiving a request, from a peripheral device coupled to said host device, for a first power-related signal;

circuitry operable for sending said first power-related signal from said host device to said peripheral device in response to said request;

a power supply operable for providing said first power-related signal; and

a first switch operable for (1) receiving said first power-related signal from said power supply, and (2) switching said first power-related signal to be sent to a first port coupled to said peripheral device in response to decoder logic coupled to said receiving circuitry.

* * * * *

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United States Patent [19]

Yokoyama

[11] Patent Number: 5,694,226

[45] Date of Patent: Dec. 2, 1997

[54] **FACSIMILE APPARATUS**

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[73] Assignee: **Ricoh Company, Ltd.**, Tokyo, Japan

[21] Appl. No.: **492,615**

[22] Filed: **Jun. 20, 1995**

[30] **Foreign Application Priority Data**

Jun. 20, 1994 [JP] Japan 6-159634

[51] **Int. Cl.**[6] **H04N 1/00**; H04N 1/41; H04N 1/46

[52] **U.S. Cl.** **358/468**; 358/400; 358/404; 358/413; 358/409; 358/503; 358/296; 399/69; 399/51; 399/70; 219/216

[58] **Field of Search** 358/296, 400, 358/422, 434, 436, 403, 468, 502, 503; 355/208, 285, 289, 290; 219/216; 399/69, 51, 70; 347/102, 171

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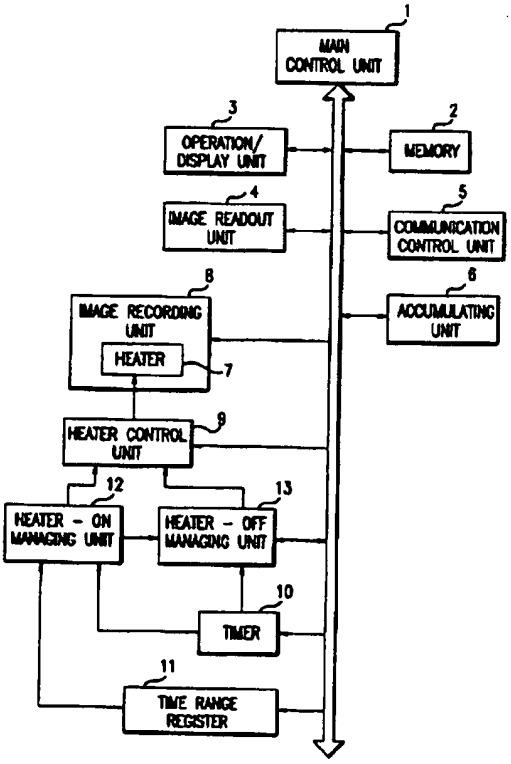
Primary Examiner—Edward L. Coles, Sr.
Assistant Examiner—Mark Wallerson
Attorney, Agent, or Firm—Oblon, Spivak, McClelland, Maier & Neustadt, P.C.

[57] **ABSTRACT**

A facsimile apparatus which includes a heater for fixing an image on a recording member and a heater control unit for controlling the heater. A timer is provided for outputting a time and a time range register registers a heater-on time range. A heater-on managing unit controls the heater control unit so that the heater is at a preheat temperature level within the heater-on time range, and so that the heater is at an image fixing temperature level when an image signal is received. Further, a heater-off managing unit controls the heater control unit so that the heater is at the image fixing temperature level out of the heater-on time range when the image signal is received. The heater-on managing unit can also shift a beginning time of the heater-on time range from a registered time to a time of a receipt of the image signal, so to extend the ending time of the heater-on time range when the image signal is received within the heater-on time range. The heater-on managing unit can also stop control of the heater control unit after the heater-on time range is over when the image signal is not received within the heater-on time range.

5 Claims, 6 Drawing Sheets



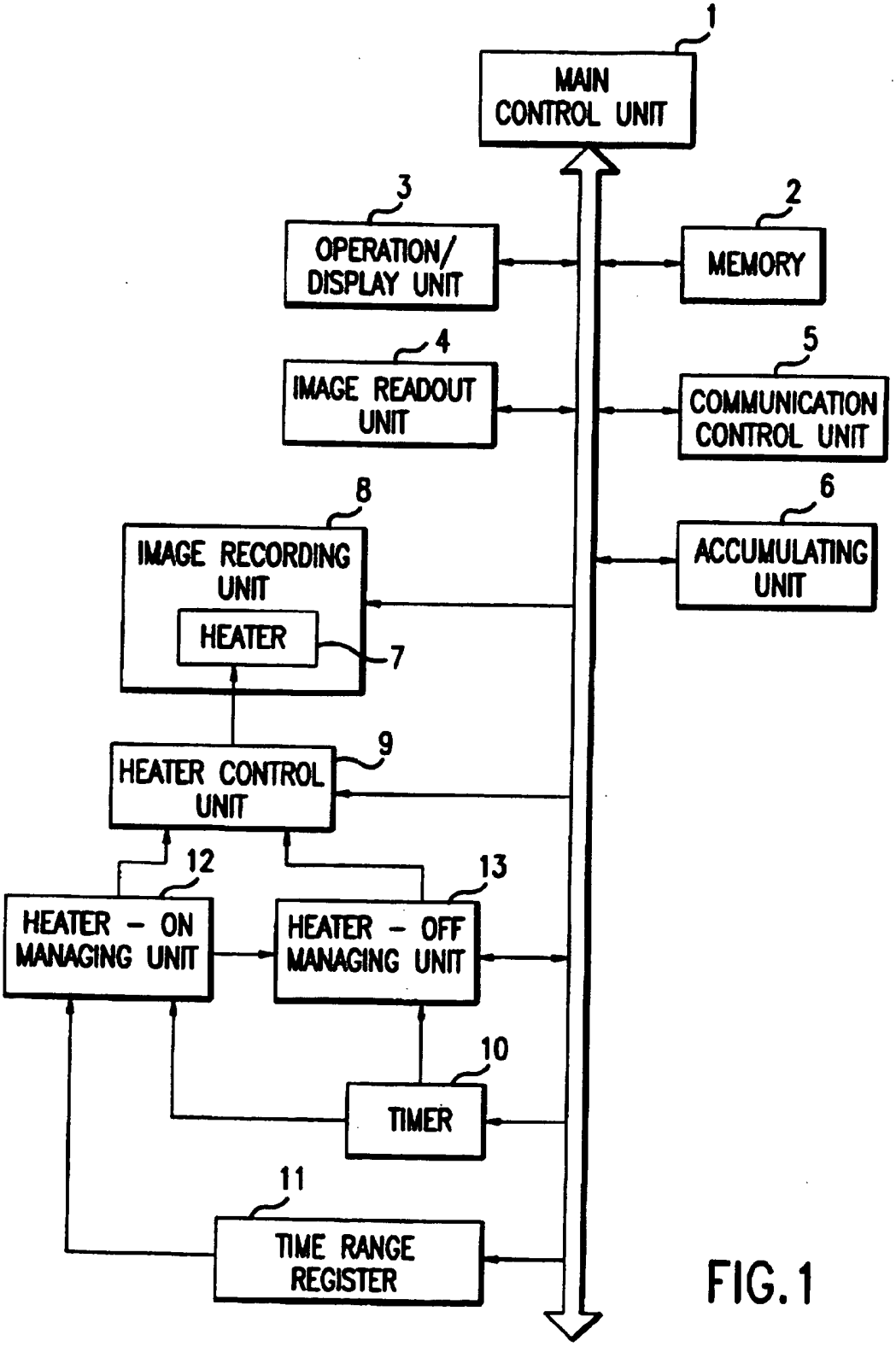

1
MAIN CONTROL UNIT
3
OPERATION/ DISPLAY UNIT
2
MEMORY
4
IMAGE READOUT UNIT
5
COMMUNICATION CONTROL UNIT
8
IMAGE RECORDING UNIT
HEATER
7
6
ACCUMULATING UNIT
9
HEATER CONTROL UNIT
12
HEATER - ON MANAGING UNIT
13
HEATER - OFF MANAGING UNIT
10
TIMER
11
TIME RANGE REGISTER

FIG. 1

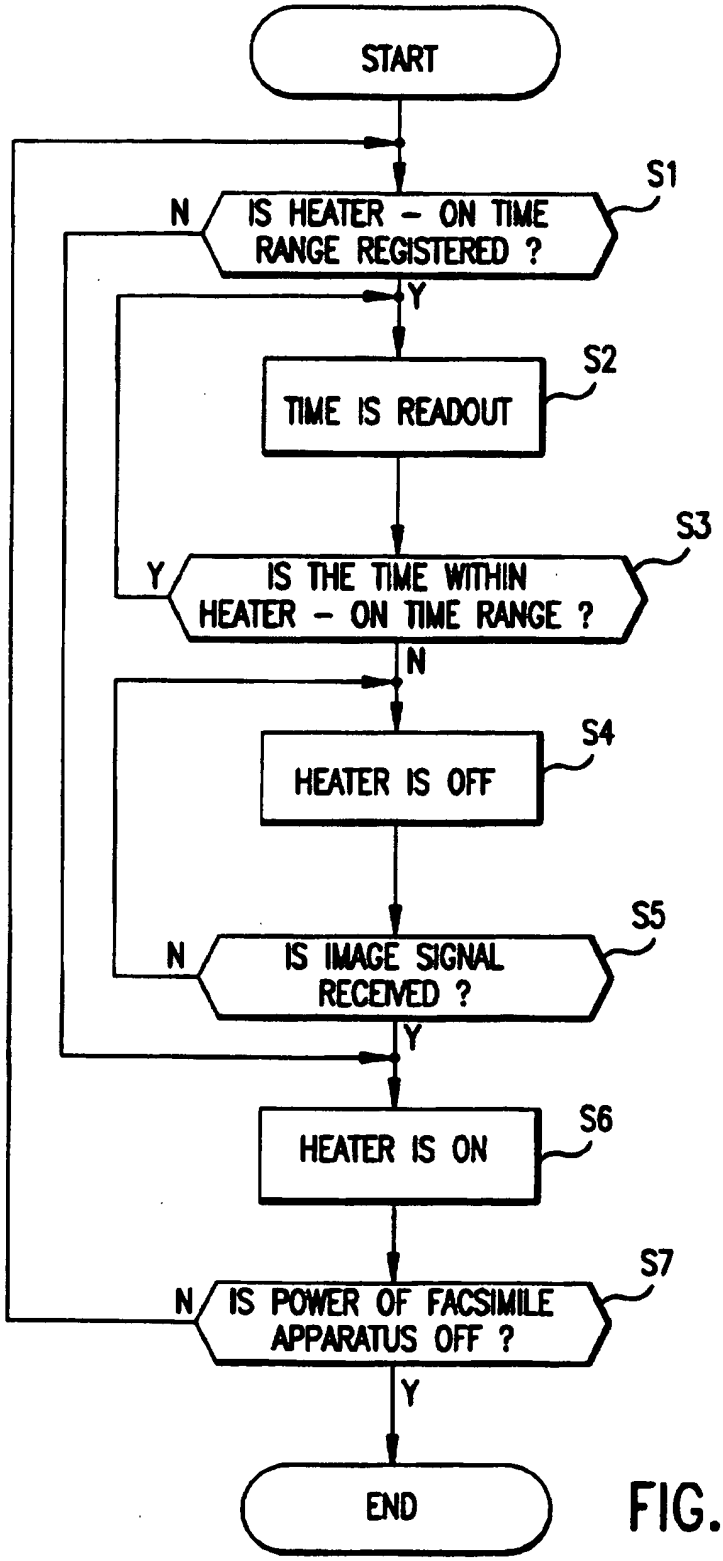

START
S1
N
IS HEATER - ON TIME RANGE REGISTERED ?
Y
S2
TIME IS READOUT
S3
Y
IS THE TIME WITHIN HEATER - ON TIME RANGE ?
N
S4
HEATER IS OFF
S5
N
IS IMAGE SIGNAL RECEIVED ?
Y
S6
HEATER IS ON
S7
N
IS POWER OF FACSIMILE APPARATUS OFF ?
Y
END

FIG.2

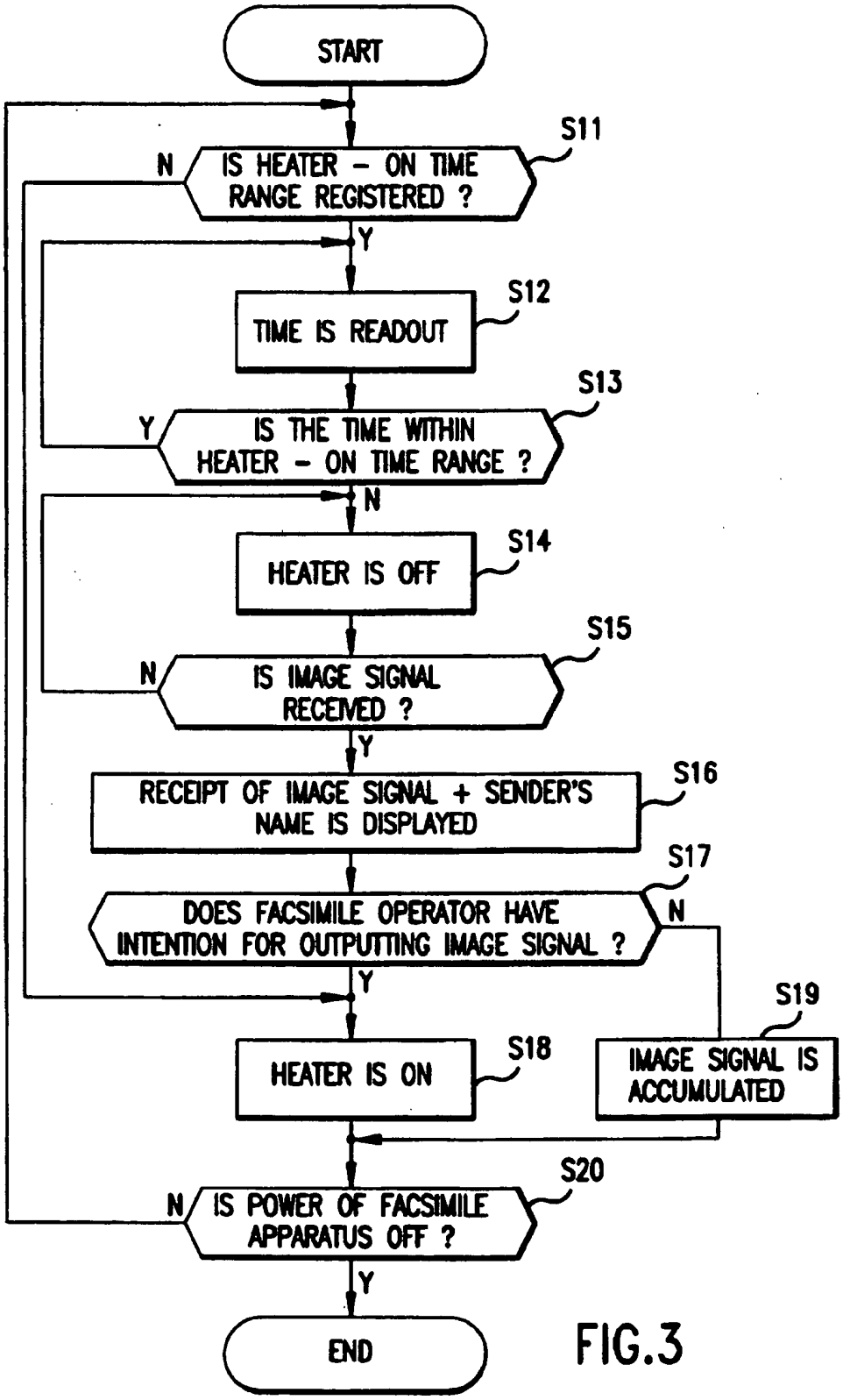

START
S11
N
IS HEATER - ON TIME RANGE REGISTERED ?
Y
S12
TIME IS READOUT
S13
Y
IS THE TIME WITHIN HEATER - ON TIME RANGE ?
N
S14
HEATER IS OFF
S15
N
IS IMAGE SIGNAL RECEIVED ?
Y
S16
RECEIPT OF IMAGE SIGNAL + SENDER'S NAME IS DISPLAYED
S17
DOES FACSIMILE OPERATOR HAVE INTENTION FOR OUTPUTTING IMAGE SIGNAL ?
N
Y
S19
S18
HEATER IS ON
IMAGE SIGNAL IS ACCUMULATED
S20
N
IS POWER OF FACSIMILE APPARATUS OFF ?
Y
END

FIG.3

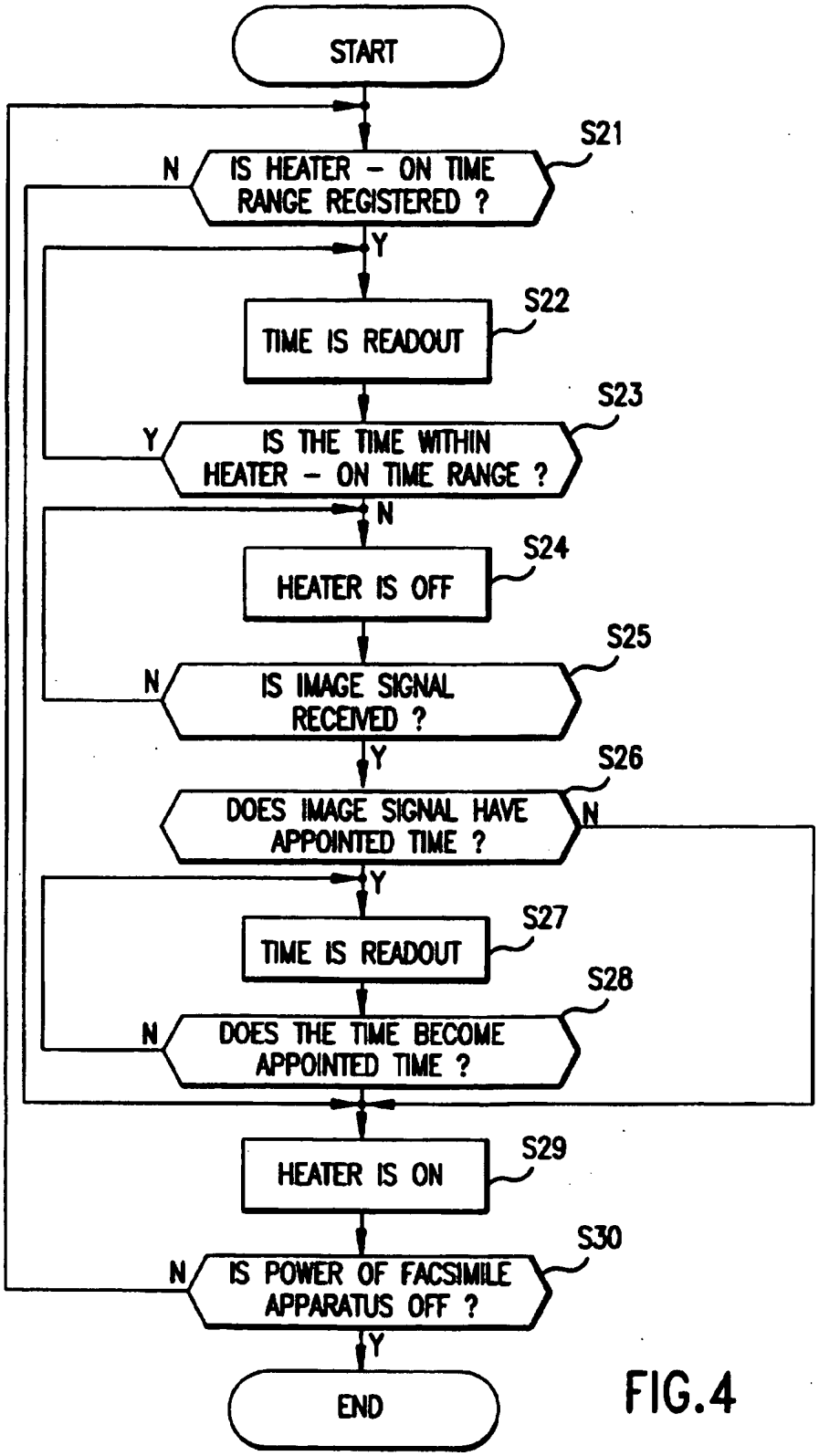

START
S21
IS HEATER - ON TIME RANGE REGISTERED ?
N
Y
S22
TIME IS READOUT
S23
IS THE TIME WITHIN HEATER - ON TIME RANGE ?
Y
N
S24
HEATER IS OFF
S25
IS IMAGE SIGNAL RECEIVED ?
N
Y
S26
DOES IMAGE SIGNAL HAVE APPOINTED TIME ?
N
Y
S27
TIME IS READOUT
S28
DOES THE TIME BECOME APPOINTED TIME ?
N
S29
HEATER IS ON
S30
IS POWER OF FACSIMILE APPARATUS OFF ?
N
Y
END

FIG.4

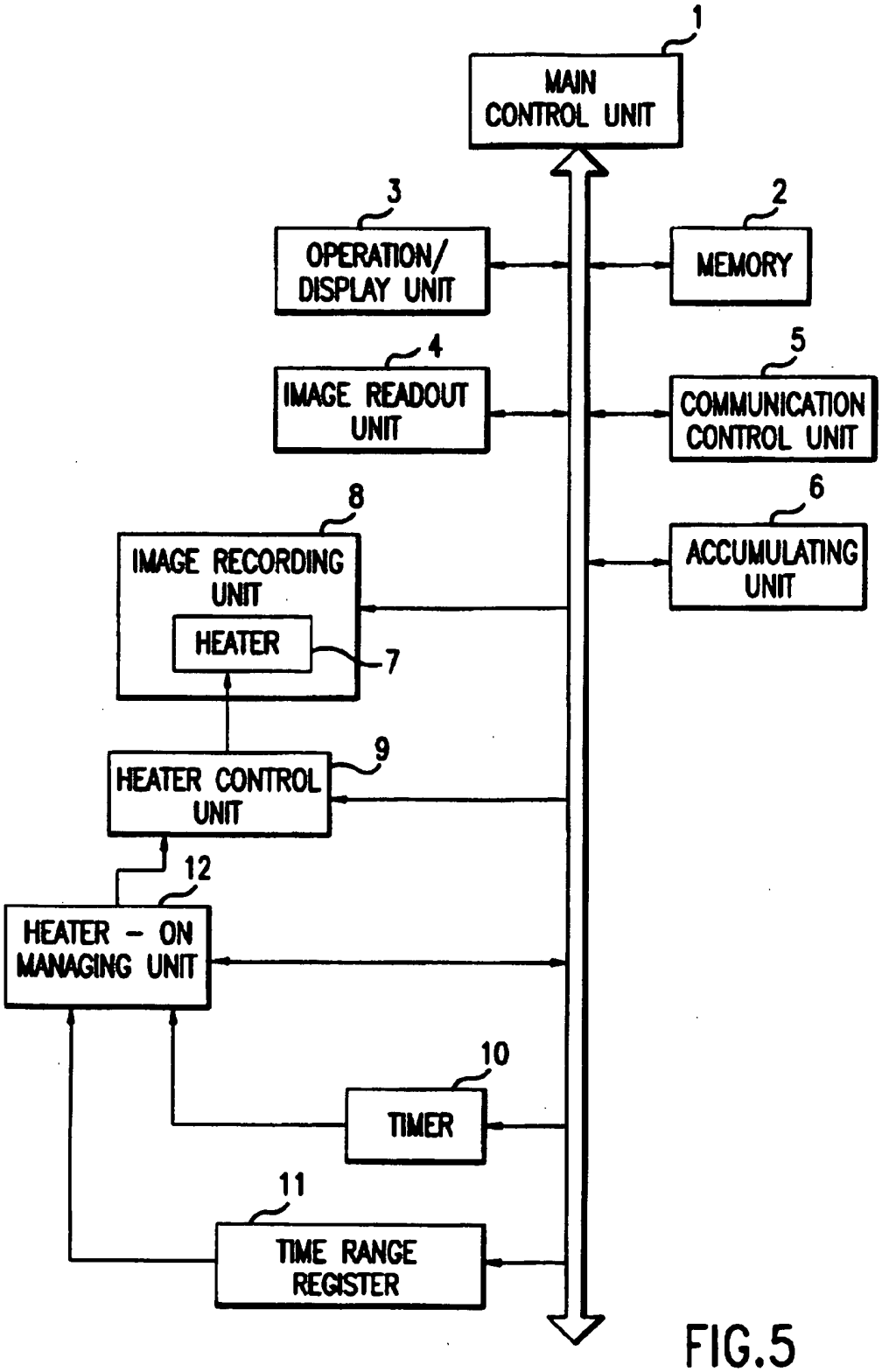

1
MAIN CONTROL UNIT
3
OPERATION/ DISPLAY UNIT
2
MEMORY
4
IMAGE READOUT UNIT
5
COMMUNICATION CONTROL UNIT
8
IMAGE RECORDING UNIT
HEATER
7
6
ACCUMULATING UNIT
9
HEATER CONTROL UNIT
12
HEATER - ON MANAGING UNIT
10
TIMER
11
TIME RANGE REGISTER

FIG.5

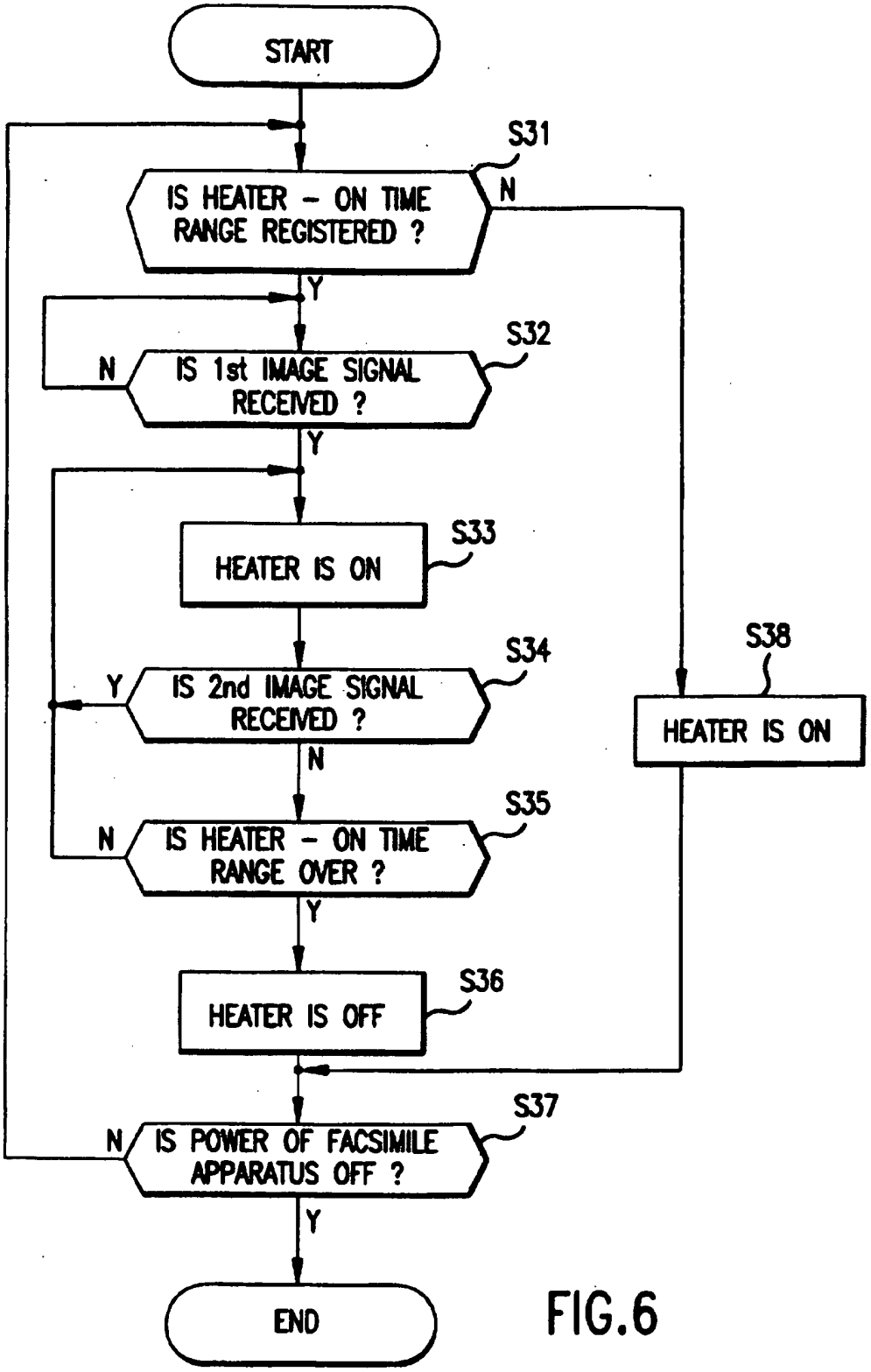

START
S31
IS HEATER - ON TIME RANGE REGISTERED ?
N
Y
S32
N
IS 1st IMAGE SIGNAL RECEIVED ?
Y
S33
HEATER IS ON
S34
Y
IS 2nd IMAGE SIGNAL RECEIVED ?
N
S35
N
IS HEATER - ON TIME RANGE OVER ?
Y
S36
HEATER IS OFF
S38
HEATER IS ON
S37
N
IS POWER OF FACSIMILE APPARATUS OFF ?
Y
END

FIG.6

FACSIMILE APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a facsimile apparatus used in an electrophotographic method. More particularly, the present invention is directed to a heater of the facsimile apparatus for fixing an image on a recording member, and control of the heater.

2. Discussion of the Background

In a facsimile apparatus for fixing an image on a recording member with heat, a heater is maintained at a pre-heat temperature level so as to reduce electric consumption. When an image signal is received and an image is outputted on the recording member, the heater heats up to an image fixing temperature level by supplying electric power to the heater in a short time.

Such a conventional system, however, suffers from a drawback in that even though the heater is maintained at the pre-heat level, the facsimile apparatus consumes a large amount of electricity.

In conventional systems, when an image signal is not frequently received, such as during the night-time or on a holiday, the heater is off. If an image signal is received at this time, an image is not outputted on the recording member, and the image is stored in a memory in the facsimile apparatus.

This kind of facsimile apparatus is disclosed in Japan laid-open No. 4-264870, 5-30315, 2-118674, 5-327964, 3-221984. However, when an image signal is not frequently received, it may be necessary that a content of the received image signal should be confirmed. In this situation, it is desired that the image is immediately outputted on the recording member when the heat remains off.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a novel facsimile apparatus which is capable of outputting an image signal on a recording member immediately when an image signal is received, even if the image signal is received out of a heater-on time range, so as to improve an operation of a facsimile apparatus.

In order to achieve the above-mentioned objects, according to the present invention, there is provided a facsimile apparatus which includes a heater for fixing an image on a recording member and a heater control unit for controlling the heater. A timer is also provided for outputting a time, and a time range register registers a heater-on time range. A heater-on managing unit controls the heater control unit so that the heater is at a pre-heat temperature level within the heater-on time range, and so that the heater is at an image fixing temperature level when an image signal is received. Further, a heater-off managing unit controls the heater control unit so that the heater is at the image fixing temperature level out of the heater-on time range when the image signal is received.

As a further feature of the present invention, a heater-on managing unit can control the heater control unit so that the heater is at the pre-heat temperature level within the heater-on time range, and so that the heater is at an image fixing temperature level when an image signal is received. The heater-on managing unit can then shift a beginning time of the heater-on time range from a registered time to a time of a receipt of the image signal, so to extend the ending time of the heater-on time range when the image signal is received within the heater-on time range. The heater-on managing unit can also stop control of the heater control unit after the heater-on time range is over when the image signal is not received within the heater-on time range.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the present invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a block diagram showing first, second, and third embodiments according to the present invention;

FIG. 2 is a flow chart showing an operation of the first embodiment of the present invention;

FIG. 3 is a flow chart showing an operation of the second embodiment of the present invention;

FIG. 4 is a flow chart showing an operation of the third embodiment of the present invention;

FIG. 5 is a block diagram showing a fourth embodiment of the present invention; and

FIG. 6 is a flow chart showing an operation of the fourth embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, and more particularly to FIG. 1 thereof, there is a block diagram showing first, second, and third embodiments of the present invention.

In FIG. 1, a facsimile apparatus has a main control unit 1 for controlling a whole operation of the facsimile apparatus, a memory 2 for storing control programs and information, an operation/display unit 3 for displaying a state of operation or performing operations such as inputting a sender's telephone number, an image readout unit 4 for reading out sending documents, a communication control unit 5 for controlling communications on lines, an accumulating unit 6 for accumulating sending or received image signals, an image recording unit 8 having a heater 7 for fixing an image on a recording member (e.g. a paper sheet), a heater control unit 9, a timer 10 (e.g. clock) for outputting a time, a time range register 11, a heater-on managing unit 12, and a heater-off managing unit 13. A heater-on time range, i.e. a time when the heater 7 is on, is registered in the time range register 11. The heater-on managing unit 12 confirms a time outputted from the timer 10 and controls the heater control unit 9 such that the heater 7 is on within the heater-on time range. The heater control unit 9 controls electricity for the heater 7. The heater-off managing unit 13 outputs received image signals from the image recording unit 8 to the recording member, when an image signal is received out of the registered heater-on time range.

An operation of the facsimile apparatus is explained hereinafter with reference to FIG. 2. FIG. 2 is a flow chart showing an operation of the first embodiment of the present invention.

In step S1, the heater-on managing unit 12 confirms that the heater-on time range is registered in the time range register 11; the heater-on time range may typically be such as from 8:00 AM to 8:00 PM. In step S2, a time outputted from the timer 10 is read out.

In step S3, the time is checked to determine if the time is within the heater-on time range or if the time is out of the

heater-on time range. If YES in step S3, i.e. if the time is within the heater-on time range, then the heater-on managing unit 12 outputs a command to the heater control unit 9 to turn on the heater 7 when the time reaches the beginning of the heater-on time range, e.g. 8:00 AM in the example noted above.

The heater control unit 9 controls electricity for the heater 7 so that the heater 7 is at the preheat temperature level within the heater-on time range. The heater-on managing unit 12 controls the heater control unit 9 so that the heater 7 is at an image fixing temperature level when the image signal is received within the heater-on time range. The heater-on managing unit 12 outputs received image signals from the image recording unit 8 to the recording member. When the output of the image signal from the image recording unit 8 is completed, the heater control unit 9 controls the electricity supply for heater 7 so that the heater 7 is at the preheat temperature level again.

If NO in step S3, then in step S4, when the heater-on managing unit 12 confirms that the time is at an end of the heater-on time range, e.g. 8:00 PM in the example noted above, then the heater control unit 9 stops controlling electricity for the heater 7 so as to cut off electricity for the heater 7. The heater-off managing unit 13 confirms that the time is out of the heater-on time range.

In step S5, it is determined if an image signal is received out of the heater-on time range.

In step S6, the heater-off managing unit 13 controls the heater control unit 9 so that the heater 7 is at the image fixing temperature level. The heater-off managing unit 13 outputs the received image signals from the image recording unit 8 to the recording member.

In step S7, when the output of the image signal from the image recording unit 8 is completed, the heater control unit 9 stops controlling electricity for the heater 7. The above-mentioned process is performed repeatedly while the power of the facsimile apparatus is on.

The heater 7 in the image recording unit 8 is on when image signals are frequently received. The heater 7 in the image recording unit 8 is off when image signals are not frequently received. In this way, electric consumption for heater 7 in the image recording unit 8 is reduced.

The heater-off managing unit 13 controls the heater control unit 9 so that the heater 7 is at the image fixing temperature level when an image signal is received out of the heater-on time range, and immediately outputs the received image signal to the recording unit 8. A facsimile operator can then easily confirm a receipt of the image signal and a content of the image signal.

A second embodiment of the present invention is explained hereinafter with reference to FIG. 3. FIG. 3 is a flow chart showing an operation of the second embodiment.

In the second embodiment, the heater-off managing unit 13 controls the heater control unit 9 so that the heater 7 is at the image fixing temperature level when an image signal is received out of the heater-on time range, and only outputs received image signals to the recording member in accordance with a facsimile operator's intention for outputting the image signals.

Step S11, step S12, and step S13 are the same as step S1, step S2, and step S3 of FIG. 2, respectively, and their detailed explanation is omitted.

In step S14, the heater-off managing unit 13 controls the heater control unit 9 which stops controlling the supply of electricity for the heater 7 so as to cut off electricity for the heater 7.

In step S15, it is determined if an image signal is received out of the heater-on time range. In step S16, the receipt of the image signal and an image signal sender's name are displayed in the operation/display unit 3.

In step S17 and step S18, the facsimile operator confirms the receipt of the image signal and the image signal sender's name on the operation/display unit 3.

When the facsimile operator has an intention for outputting an image signal, the heater-off managing unit 13 controls the heater control unit 9 so that the heater 7 is at the image fixing temperature level when an image signal is received out of the heater-on time range and outputs the received image signal to the recording unit 8.

In step S19, when the facsimile operator has no intention for outputting the image signal, the received image signal is accumulated in the accumulating unit 6. Then, when the time of the beginning of the heater-on time range arrives, the image signals accumulated in the accumulating unit 6 are outputted to the recording unit 8.

A third embodiment of the present invention is explained hereinafter with reference to FIG. 4. FIG. 4 is a flow chart showing an operation of the third embodiment.

In the third embodiment, step S21, step S22, step S23, and step S24 are the same as step S1, step S2, step S3, and step S4 of FIG. 1, respectively, and their detailed explanation is omitted.

In step S25, it is determined if an image signal is received out of the heater-on time range. In step S26, it is determined if the image signal has an appointed time for image output, and the main control unit 1 sends the information of the appointed time to the heater-off managing unit 13. The existence of the appointed time is checked during a protocol procedure for the facsimile apparatus at the time of receiving or sending an image signal.

In step S27, the heater-off managing unit 13 reads out the time outputted from the timer 10. In step S28, the read out time becomes the appointed time. In step S29, the heater-off managing unit 13 controls the heater control unit 9 so that the heater 7 is at the image fixing temperature level and the received image signal is output to the recording unit 8.

When an image signal which is received out of the heater-on time range has no appointed time for an image output, the heater-off managing unit 13 controls the heater control unit 9 so that the heater 7 is at the image fixing temperature level and the received image signal is output to the recording unit 8 immediately.

A fourth embodiment of the present invention is explained hereinafter with reference to FIG. 5. FIG. 5 is a block diagram showing the fourth embodiment.

The same members in FIG. 5 have the same reference numerals in FIG. 1, and their detailed explanation is omitted here.

In FIG. 5, the heater-on time range is registered in the time range register 11, such as from 8:00 AM to 9:00 AM (one hour).

The heater-on managing unit 12 controls the heater control unit 9 so that the heater 7 is at the image fixing temperature level when a first image signal is received within the heater-on time range, e.g. at 8:10 AM. The heater-on managing unit 12 controls the heater control unit 9 so that the heater 7 is at the image fixing temperature level when a second image signal is received within the heater-on time range, e.g. at 8:30 AM, and this also shifts the beginning time of the heater-on time range (e.g. 8:00 AM) to a time of receipt of the second image signal (e.g. 8:30 AM),

so as to extend the ending time of the heater-on time range (e.g. 9:00 AM→9:30 AM).

The heater-on managing unit **12** stops control of the heater control unit **9** after the heater-on time range is over when a second image is not received within the heater-on time range.

An operation of the facsimile apparatus of FIG. **5** is explained hereinafter with reference to FIG. **6**. FIG. **6** is a flow chart showing an operation of a fourth embodiment of the present invention.

In step **S31**, step **S32**, and step **S33**, the heater-on time range is registered in the time range register **11**, such as from 8:00 AM to 9:00 AM (one hour).

When a first image signal is received within the heater-on time range, e.g. at 8:10 AM, the heater-on managing unit **12** controls the heater control unit **9** so that the heater **7** is at the image fixing temperature level and the received first image signal is outputted from the image recording unit **8** to the recording member.

In step **S34**, when second image signal is received within the heater-on time range, e.g. at 8:30 AM, the heater-on managing unit **12** controls the heater control unit **9** so that the heater is at the image fixing temperature level, and shifts the beginning time of the heater-on time range (e.g. 8:00 AM) to a time of receipt of the second image signal (e.g. 8:30 AM), so as to extend the ending time of the heater-on time range (e.g. 9:00 AM→9:30 AM).

The received second image signal is then outputted from the image recording unit **8** to the recording member.

In step **S35**, and step **S36**, when the second image signal is not received within the heater-on time range (8:00 AM to 9:00 AM), the heater-on managing unit **12** stops the operation of the heater control unit **9**. The heater **7** in the image recording unit **8** is then off.

In step **S37**, the above-mentioned process is performed repeatedly while the power of the facsimile apparatus is on.

In step **S38**, when the heater-on time range is not registered in the time range register **11**, the heater-on managing unit **12** controls the heater control unit **9** so that the heater **7** is at an image fixing temperature level at the receipt of the image signal. The received image signal is outputted from the image recording unit **8** the recording member. The heater **7** in the image recording unit **8** is on when image signals are frequently received. The heater **7** in the image recording unit **8** is off when image signals are not frequently received. Electric consumption for heater **7** in the image recording unit **8** is thus reduced.

In the above-mentioned step **S34**, when the second signal is received, the heater-on managing unit **12** shifts the beginning time of the heater-on time range to a time of receipt of the second image signal. Also, as a modification of the fourth embodiment, when the first signal is received at, e.g., 8:10 AM, the heater-on managing unit **12** shifts the beginning time of the heater-on time range (e.g. 8:00 AM) to a time at receipt of the first image signal (e.g. 8:10 AM) so as to extend the ending time of the heater-on time range (e.g. 9:00 AM→9:10 AM).

Obviously, numerous additional modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the present invention may be practiced otherwise than as specifically described herein.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A facsimile apparatus comprising:

a heater for fixing an image on a recording member;

a heater control unit for controlling the heater;

a timer for outputting a time;

a time range register for registering a heater-on time range;

a heater-on managing unit for controlling said heater control unit so that said heater is at a preheat temperature level within said heater-on time range, and so that said heater is at an image fixing temperature level when an image signal is received; and

a heater-off managing unit for controlling said heater control unit to be at the image fixing temperature level when the image signal is received at a time out of said heater-on time range;

wherein said heater-off managing unit displays a receipt of the image signal on a displaying unit when the image signal is received out of said heater-on time range, and said heater-off managing unit controls said heater control unit so that said heater is at the image fixing temperature level only when an image output command from an operation is generated.

2. The facsimile apparatus according to claim **1**, wherein said heater-off managing unit controls said heater control unit at an appointed time so that said heater is at the image fixing temperature level, if the image signal has said appointed time for image output, when the image signal is received out of said heater-on time range.

3. A facsimile apparatus comprising:

heating means for fixing an image on a recording member;

heater control means for controlling the heater means;

timer means for outputting a time;

time range register means for registering a heater-on time range;

heater-on managing means for controlling said heater control means so that said heater means is at a preheat temperature level within said heater-on time range, and so that said heater means is at an image fixing temperature level when an image signal is received; and

a heater-off managing means for controlling said heater control means to be at the image fixing temperature level when the image signal is received at a time out of said heater-on time range;

wherein said heater-off managing means displays a receipt of the image on a display means when the image signal is received out of said heater-on time range, and said heater-off managing means controls said heater control means so that said heater means is at the image fixing temperature level only when an image output command from an operator is generated.

4. The facsimile apparatus according to claim **3**, wherein said heater-off managing means controls said heater control means at an appointed time so that said heater means is at the image fixing temperature level, if the image signal has said appointed time for image output, when the image signal is received out of said heater-on time range.

5. A facsimile apparatus comprising:

a heater for fixing an image on a recording member;

a heater control unit for controlling the heater;

a timer for outputting a time;

a time range register for registering a heater-on time range; and

a heater-on managing unit for controlling said heater control unit so that said heater is at a preheat temperature level within said heater-on time range, and so that said heater is at an image fixing temperature level when an image signal is received, and for automatically shifting at least one of a beginning time and an ending time of said heater-on time range from a registered time to a time based on a receipt of the image signal, so as to extend an ending time of said heater-on time range when the image signal is received within said heater-on time range, and

for stopping control of said heater control unit after said heater-on time range is over when the image signal is not received within said heater-on time range.

* * * * *

US005805780A

United States Patent [19]

Kawai et al.

[11] Patent Number: 5,805,780

[45] Date of Patent: Sep. 8, 1998

[54] **PHOTOGRAPHING BOX**

[75] Inventors: **Satoru Kawai; Mitsuhiro Hamashima; Tatsuya Kita**, all of Tokyo, Japan

[73] Assignee: **Dai Nippon Printing Co., Ltd.**, Japan

[21] Appl. No.: **248,977**

[22] Filed: **May 25, 1994**

[30] **Foreign Application Priority Data**

May 25, 1993	[JP]	Japan	5-122643
Jun. 15, 1993	[JP]	Japan	5-143681
Oct. 19, 1993	[JP]	Japan	5-283909
Oct. 19, 1993	[JP]	Japan	5-283910
Oct. 29, 1993	[JP]	Japan	5-292383

[51] **Int. Cl.**[6] **B41B 15/00**; B41J 15/00; G06F 15/00

[52] **U.S. Cl.** **395/117**; 395/101; 395/108; 347/103; 396/2; 358/296; 358/503; 358/909.1

[58] **Field of Search** 395/117, 101, 395/108; 358/443, 909.1, 503, 302, 296; 364/226.1; 347/56, 61, 62, 103, 174, 187; 396/1, 2, 580, 429; 355/27

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5-8426	1/1993	Japan	B41J 2/35

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Primary Examiner—Kim Yen Vu

Assistant Examiner—Kimberly A. Williams

Attorney, Agent, or Firm—Parkhurst & Wendel

[57] **ABSTRACT**

A photographing box is arranged to reduce a time taken from photographing an object to printing the image of the object. The photographing box is intended to be manufactured at low cost and more easily maintained. The photographing box includes a photographing mechanism house for housing a photographing mechanism and a photographing space section. If paid, the photographing device is operated to illuminate an object, photograph the object, and do some image processing like image magnification or reduction or image layout. Plural images sized for different uses output on one cut sheet by a sublimation transfer printer. The photographing box operates to print out the image at high speed and is manufactured at low cost and more easily maintained.

12 Claims, 19 Drawing Sheets

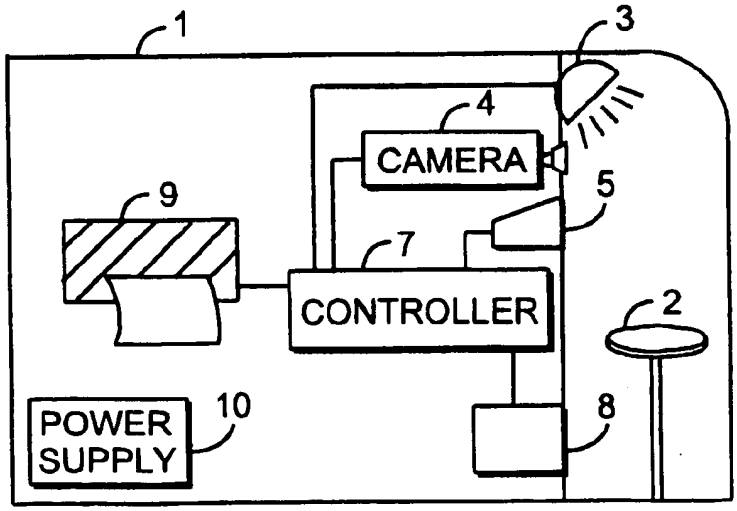


FIG. 1

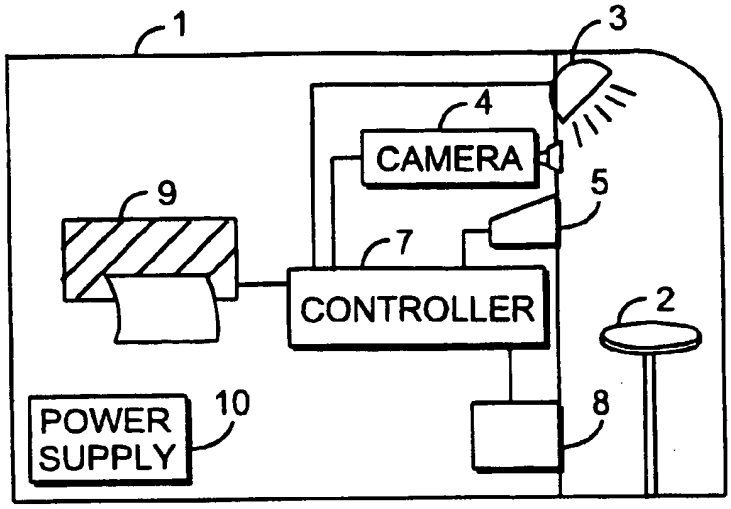


FIG. 2

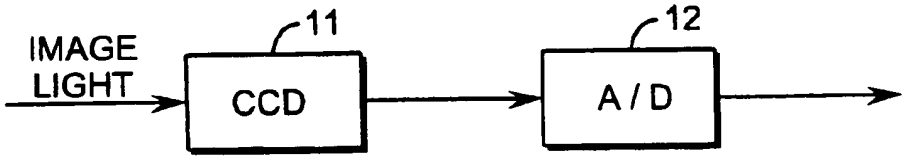


FIG. 3

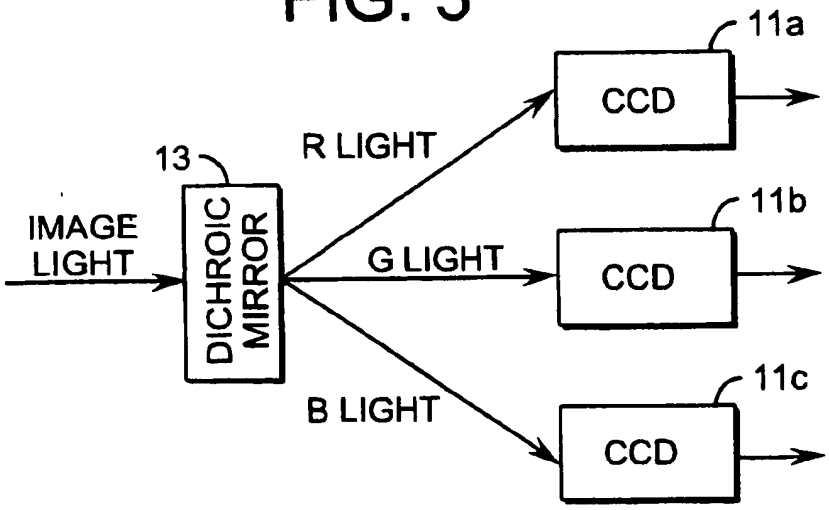


FIG. 4(a)

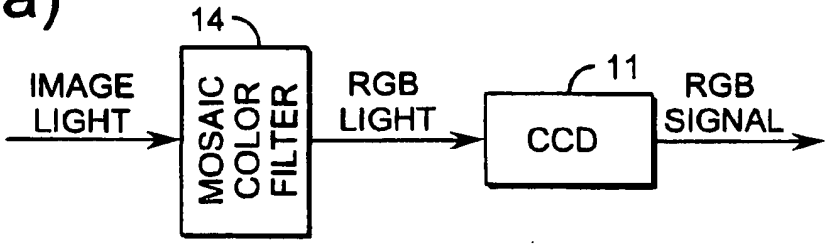


FIG. 4(b)

FIG. 5(a)

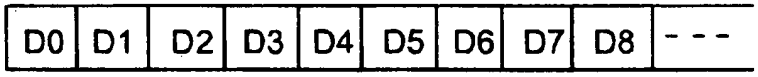


FIG. 5(b)

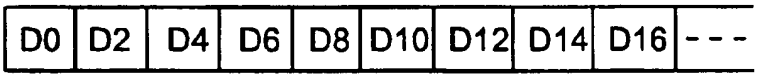
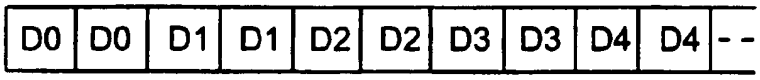


FIG. 5(c)



0	-1	0
-1	5	-1
0	-1	0

FIG. 6(a)

-1	-1	-1
-1	9	-1
-1	-1	-1

FIG. 6(b)

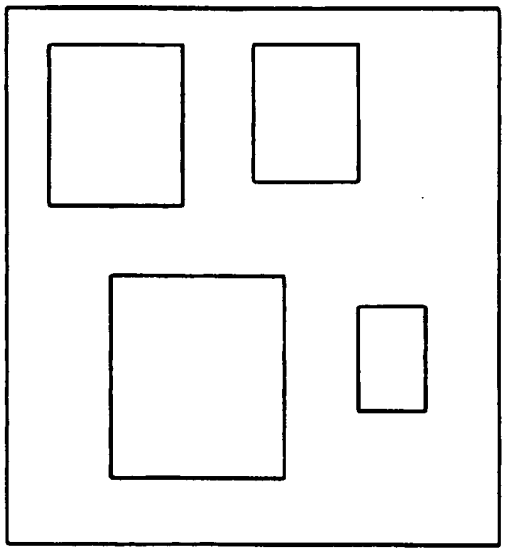


FIG. 7

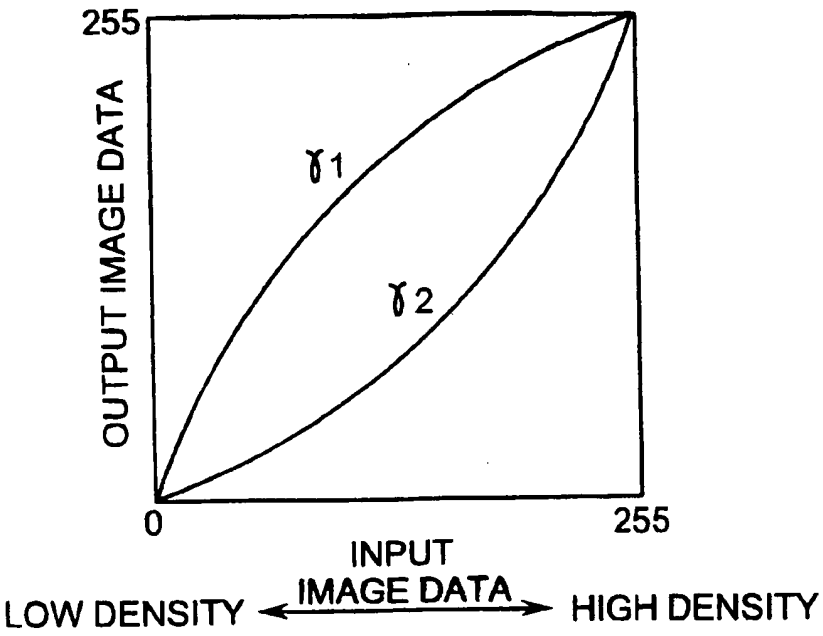

255
OUTPUT IMAGE DATA
γ1
γ2
0
255
INPUT
IMAGE DATA
LOW DENSITY
HIGH DENSITY

FIG. 8

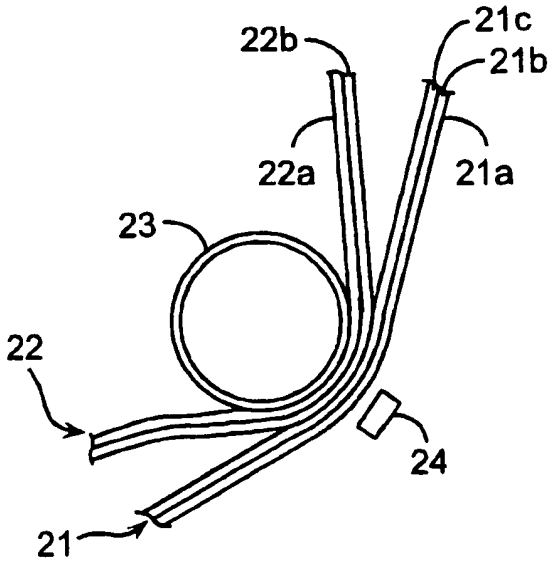

22b
21c
21b
22a
21a
23
22
24
21

FIG. 9

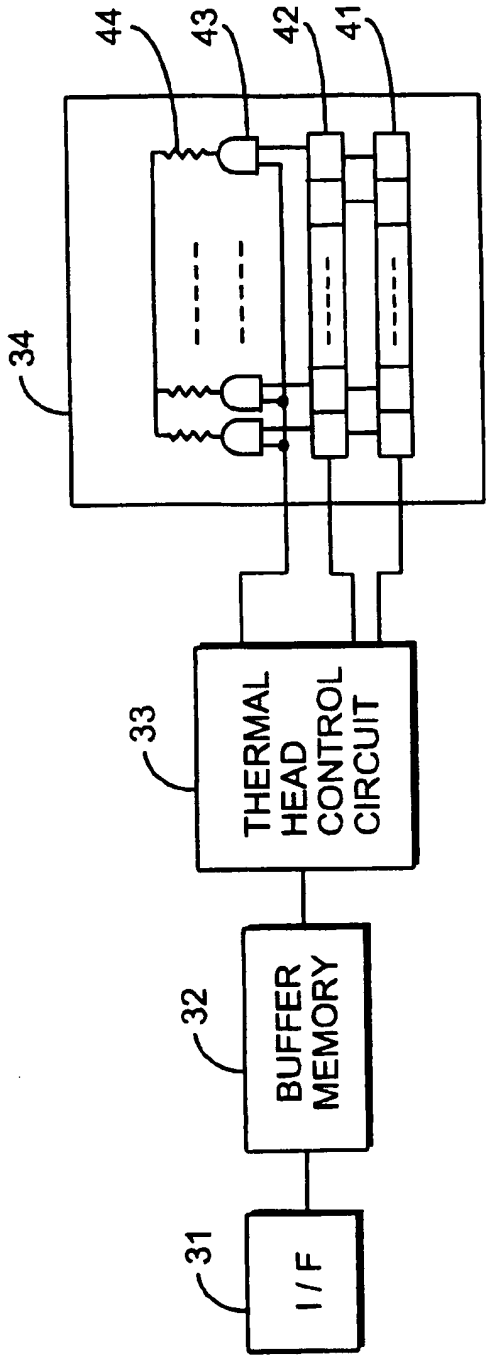

44
43
42
41
34
33
THERMAL HEAD CONTROL CIRCUIT
32
BUFFER MEMORY
31
I/F

FIG. 10

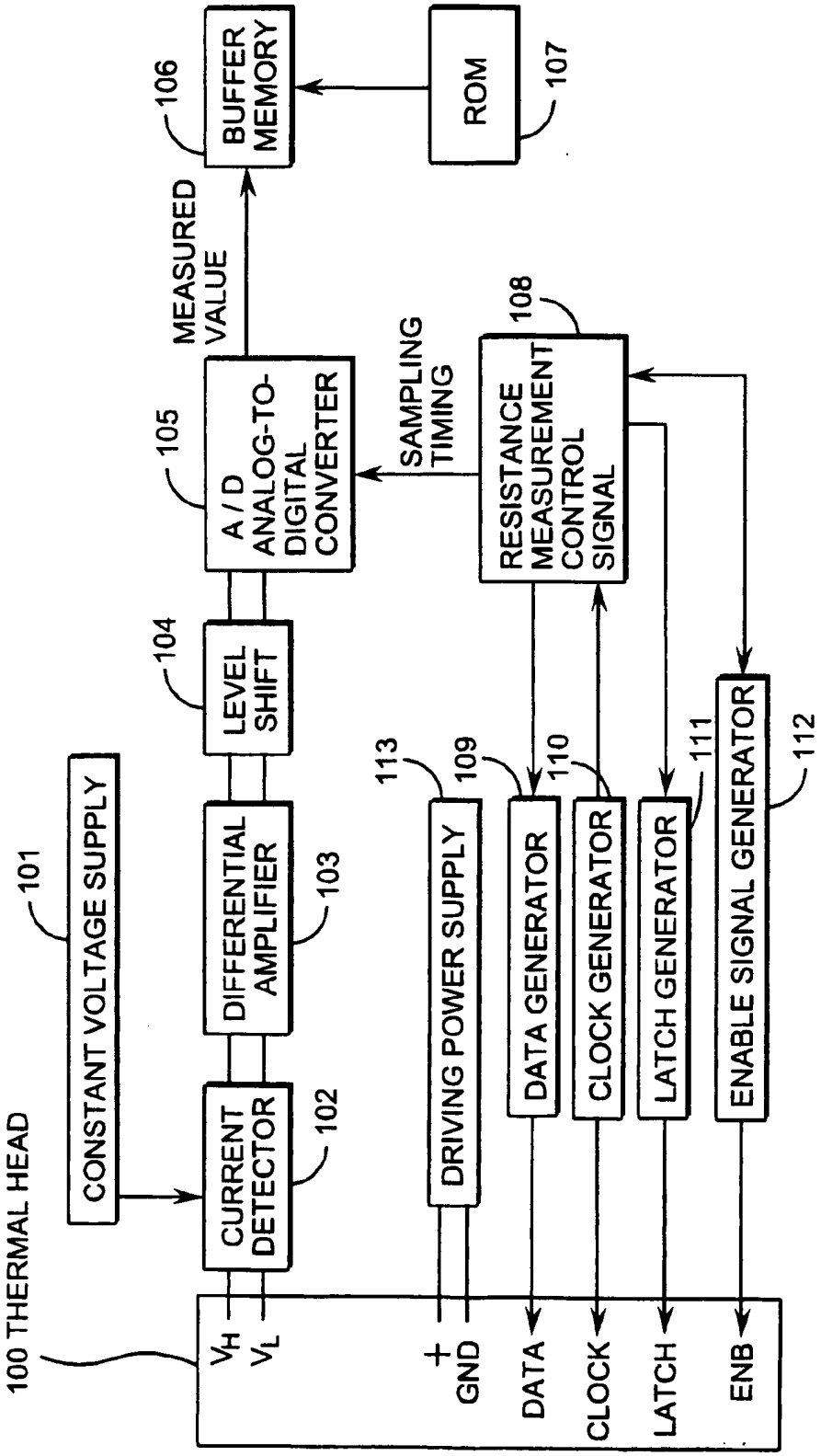

100 THERMAL HEAD
CONSTANT VOLTAGE SUPPLY
101
CURRENT DETECTOR
102
DIFFERENTIAL AMPLIFIER
103
LEVEL SHIFT
104
A / D ANALOG-TO-DIGITAL CONVERTER
105
BUFFER MEMORY
106
ROM
107
RESISTANCE MEASUREMENT CONTROL SIGNAL
108
DRIVING POWER SUPPLY
109
DATA GENERATOR
110
CLOCK GENERATOR
LATCH GENERATOR
111
ENABLE SIGNAL GENERATOR
112
113
MEASURED VALUE
SAMPLING TIMING
V_H
V_L
+
GND
DATA
CLOCK
LATCH
ENB

FIG. 11

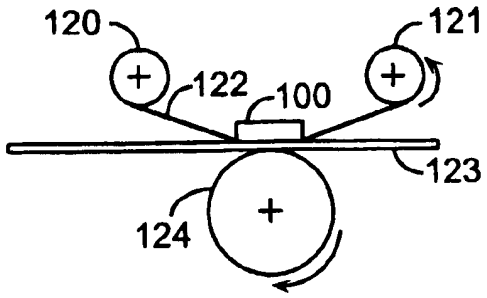


FIG. 12(a)

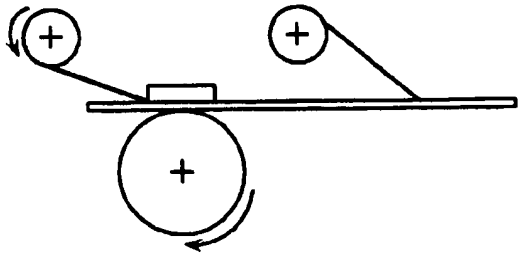


FIG. 12(b)

FIG. 13(a)

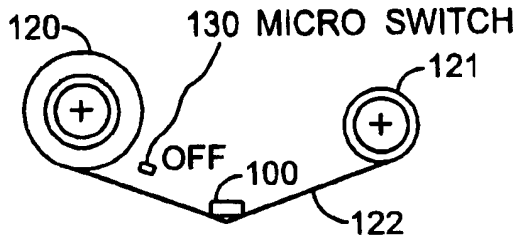


FIG. 13(b)

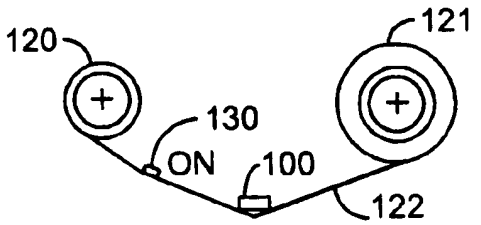
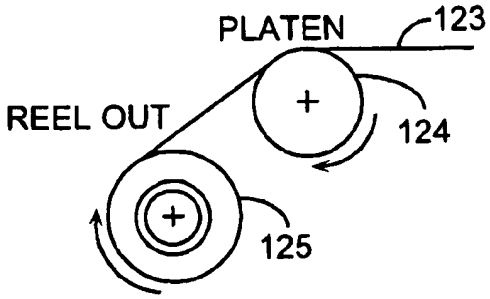


FIG. 14(a)



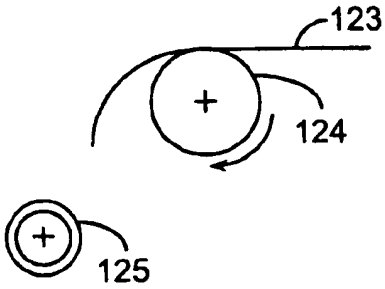


FIG. 14(b)

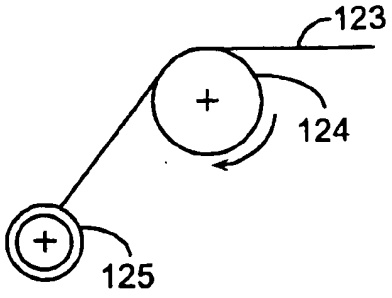


FIG. 14(c)

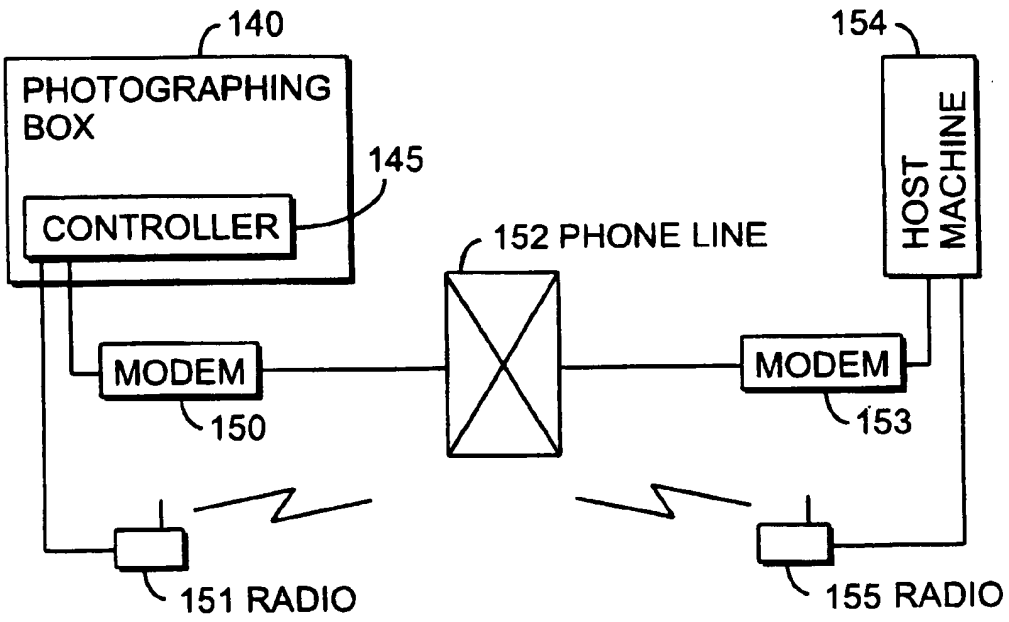

140
PHOTOGRAPHING BOX
145
CONTROLLER
152 PHONE LINE
154
HOST MACHINE
MODEM
150
MODEM
153
151 RADIO
155 RADIO

FIG. 15

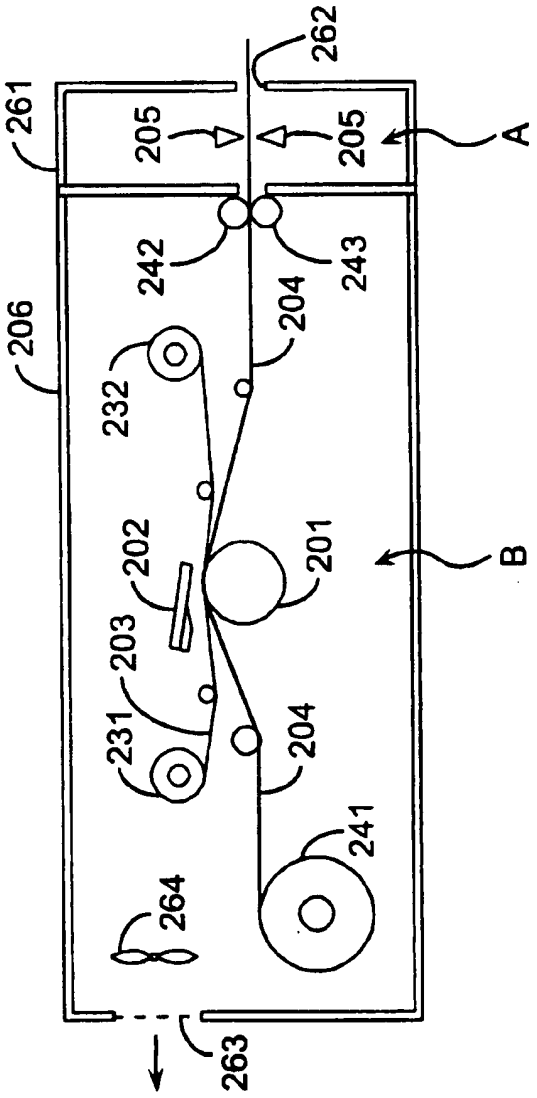

262
261
205
205
A
242
243
204
206
232
202
201
B
203
231
204
241
264
263

FIG. 16

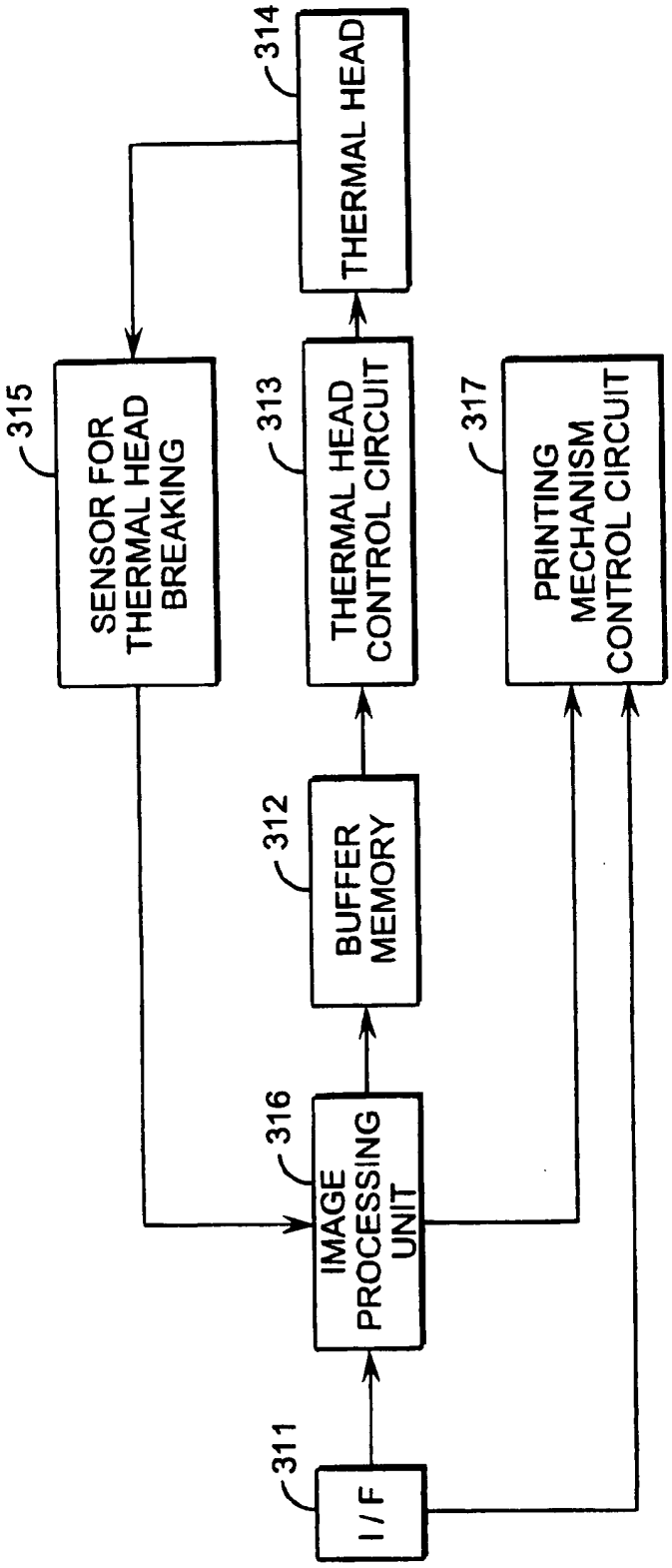

314
THERMAL HEAD
315
SENSOR FOR THERMAL HEAD BREAKING
313
THERMAL HEAD CONTROL CIRCUIT
317
PRINTING MECHANISM CONTROL CIRCUIT
312
BUFFER MEMORY
316
IMAGE PROCESSING UNIT
311
I/F

FIG. 17

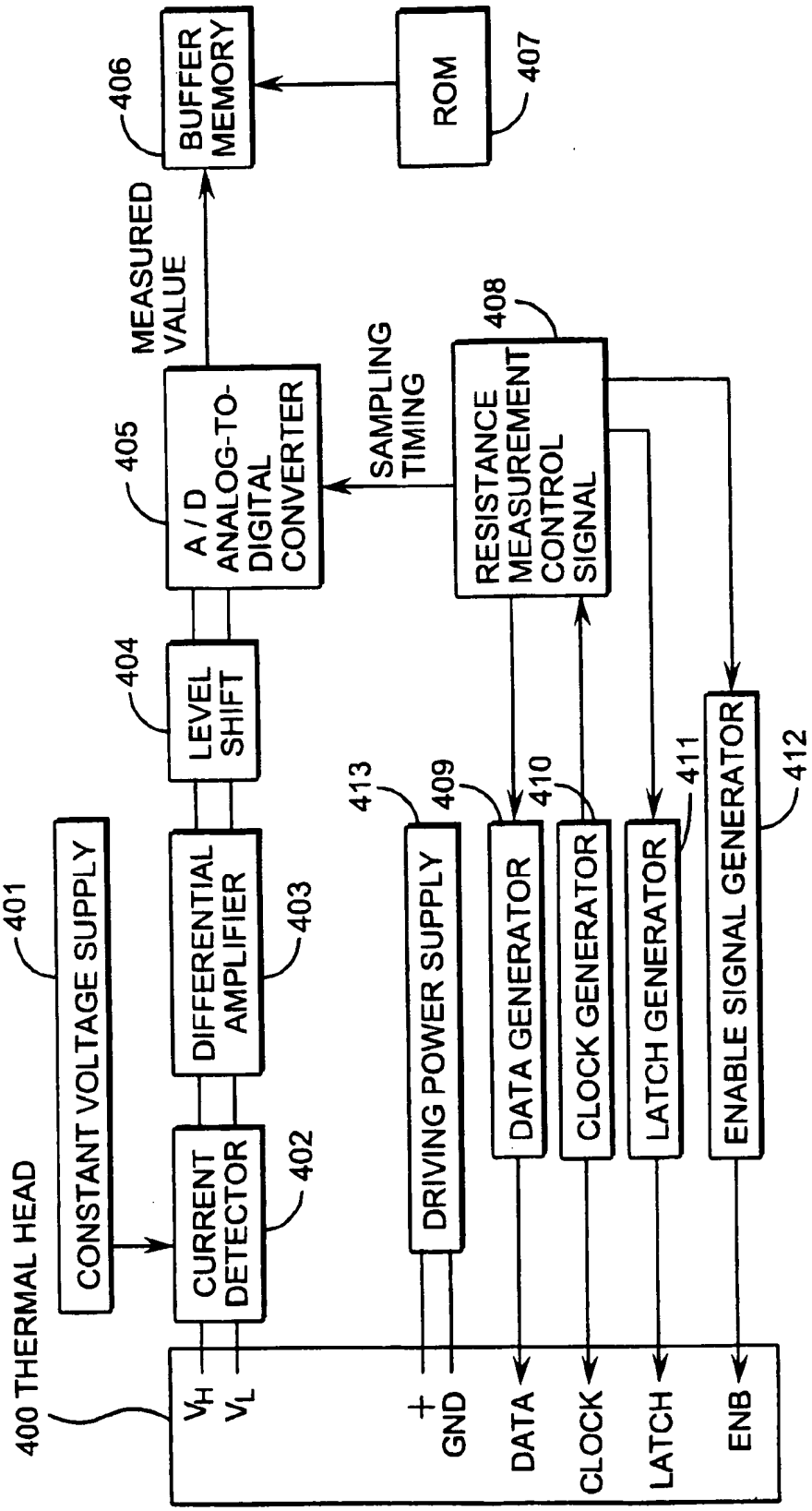

400 THERMAL HEAD
401
CONSTANT VOLTAGE SUPPLY
402
CURRENT DETECTOR
403
DIFFERENTIAL AMPLIFIER
404
LEVEL SHIFT
405
A/D ANALOG-TO-DIGITAL CONVERTER
406
BUFFER MEMORY
407
ROM
408
RESISTANCE MEASUREMENT CONTROL SIGNAL
409
DRIVING POWER SUPPLY
410
DATA GENERATOR
411
CLOCK GENERATOR
412
LATCH GENERATOR
413
ENABLE SIGNAL GENERATOR
MEASURED VALUE
SAMPLING TIMING
VH
VL
+
GND
DATA
CLOCK
LATCH
ENB

FIG. 18

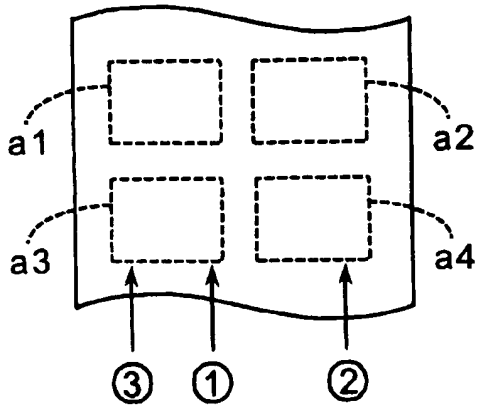


FIG. 19

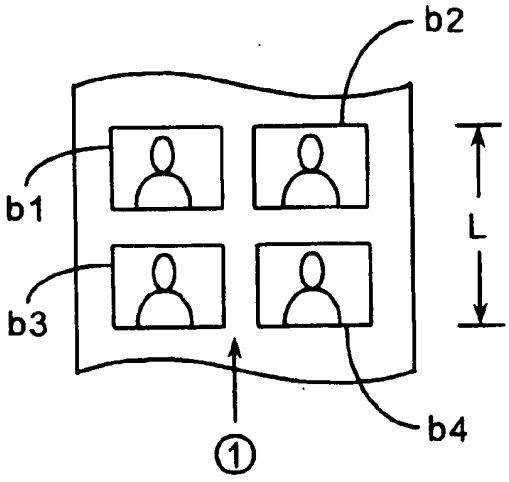


FIG. 20

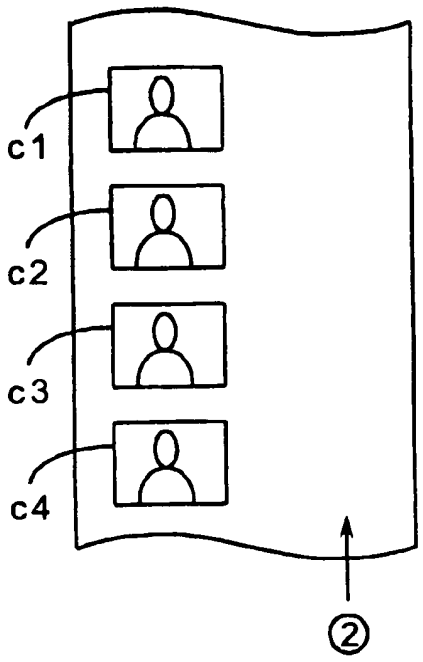


FIG. 21

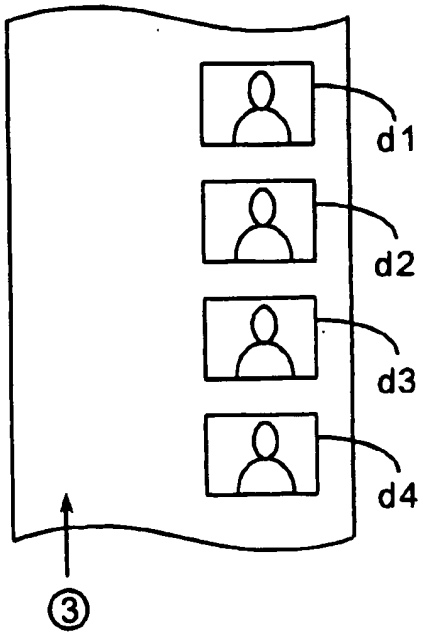


FIG. 22

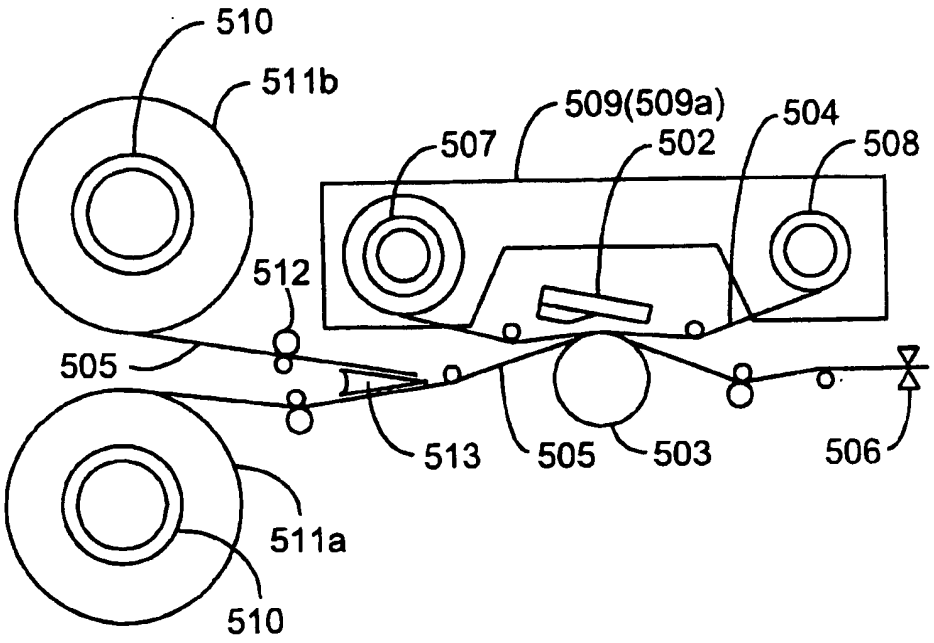

510
511b
509(509a)
504
507
502
508
512
505
513
505
503
506
511a
510

FIG. 23

FIG. 24

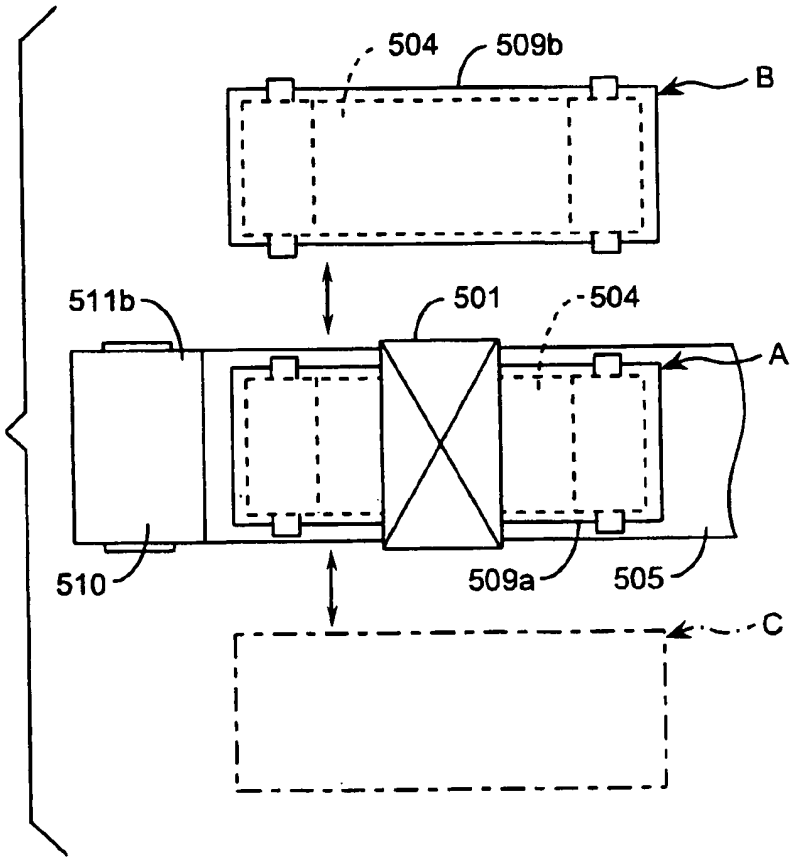


FIG. 25(a)

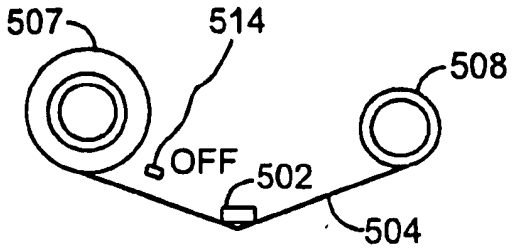


FIG. 25(b)

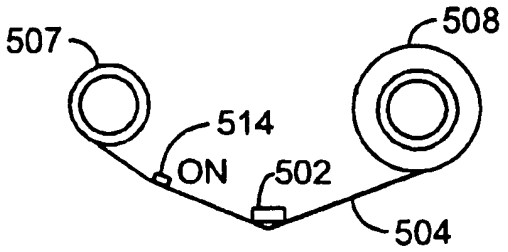
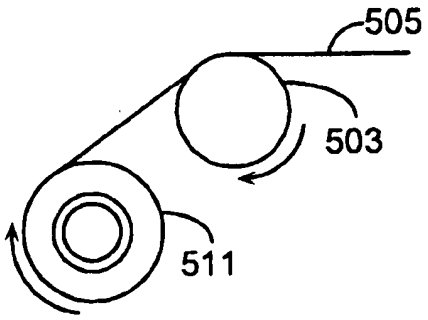


FIG. 26(a)



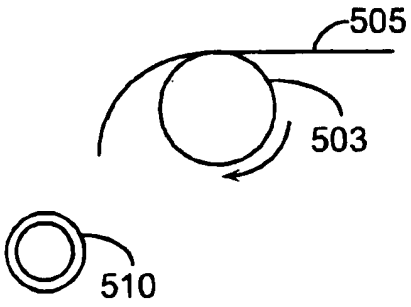


FIG. 26(b)

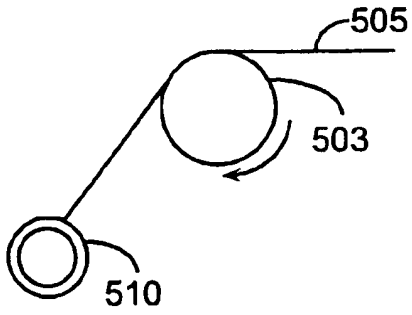


FIG. 26(c)

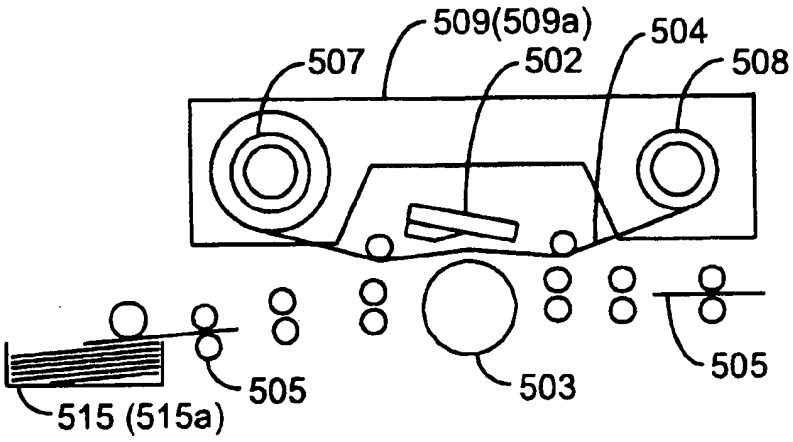
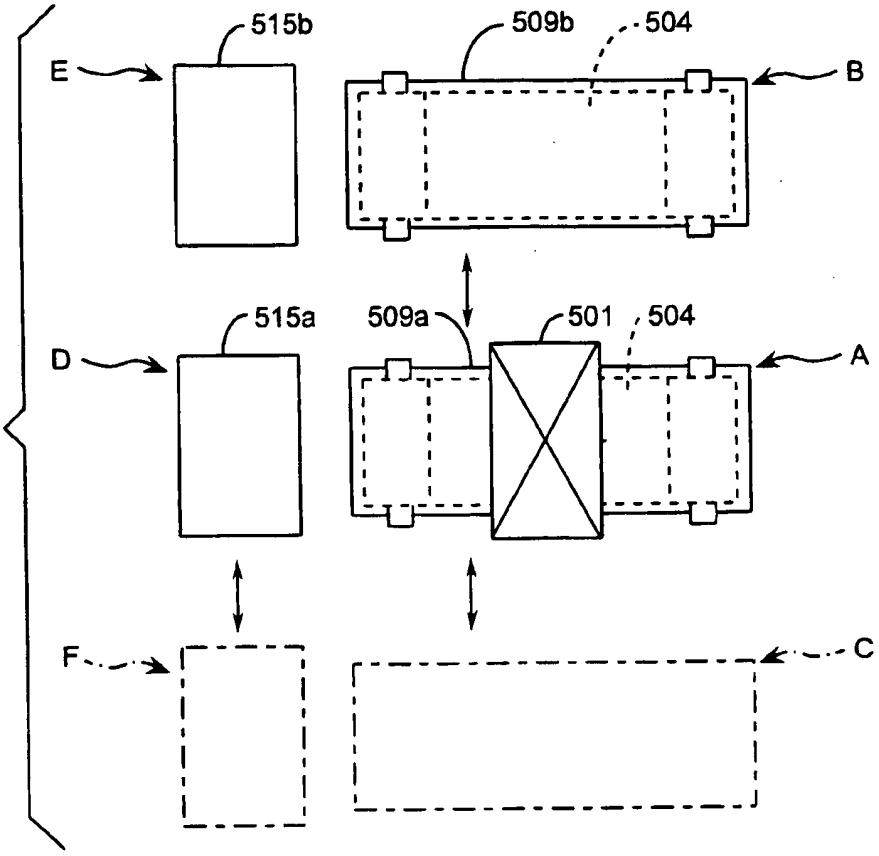


FIG. 27

FIG. 28



PHOTOGRAPHING BOX

BACKGROUND OF THE INVENTION

The present invention relates to a photographing box which includes a photographing mechanism for taking the steps of photographing an object such as a figure, perform the necessary processing of the video signal, and print out the picture according to the charges given by a user, and a thermal transfer recording apparatus which is intended to be used as one of several possible ways to the automatic photographing boxes.

It has been conventionally known an instant photographing system such as a silver photo system or a diffusing transfer type silver photo system as means for outputting a printed picture after about only a few minutes. The silver photo system needs a few minutes consumed from the end of the photographing to the output of the printed photo and to provide a developing solution and a fixing solution for wet processing. The system therefore has to do a troublesome operation of exchanging the solutions and maintaining the relevant equipment. Further, since the atmospheric temperature is greatly effects the image quality, the temperatures of the solutions are required to be minutely controlled. The diffusing transfer type silver photographing system needs to do a very costly running process.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a photographing box which provides a sublimation transfer system and operates to output a printed image within about one or two minutes and to be maintained easily and at low cost.

It is a further object of the present invention to provide a monitoring mechanism for the thermal transfer recording which operates to automatically detect trouble in a thermal transfer printer or a system having the thermal transfer printer and give a report about the sensed result.

It is a yet further object of the present invention to provide a thermal transfer recording apparatus which enables to prevent any defective print or failure caused by the adverse effect of paper dust brought about when cutting a dye transfer sheet or dirt intruded from the outside.

It is another object of the present invention to provide an automatic layout mechanism for thermal transfer recording which is arranged to detect if an abnormal state occurs in a thermal head of the thermal transfer printer and obtain a desired recording image if it is sensed.

It is another object of the present invention to provide a thermal transfer printer which enables to prevent disability of printing caused in an out of paper state.

In carrying out the above objects, the present invention is arranged as follows.

According to a first aspect of the invention, an automatic photographing box includes a photographing mechanism house for housing a photographing mechanism and a photographing space, the photographing mechanism having means for lighting an object, means for photographing the object illuminated by the lighting means, image processing means for receiving an object image signal from the photographing means and having at least a magnifying or reducing function and an image layouting function, a sublimation transfer printer for receiving a processed image signal and printing the image on the image data signal, and control means for controlling the lighting means, photographing means, image processing means and sublimation transfer printer.

This invention further provides a monitor for displaying an image of an object to be imaged.

This invention further provides a money handling mechanism and is arranged to generate a start signal from the money handling mechanism.

The photographing box according to the present invention uses a photographing device such as a video camera or a still video camera or a leased photographing device and activates the photographing mechanism to image an object, do an image magnification or layout the image of the object, and output plural images on a sheet, each image sized to each way of use such as a license or a passport from the sublimation transfer printer if a user pays for it by any method like cash or a pre-paid card. The photographing box uses the dry process and the heat-sensitive sublimation printer. Hence, it enables to quickly print out the photograph and may be made less costly. Further, the photographing box provides a monitor so that the image may be checked before printing it out and be imaged again.

According to a second aspect of the present invention, a thermal transfer printer for the photographing box providing means for feeding a dye transfer sheet and an image receiving sheet, a thermal head for pressing the dye transfer sheet and the thermal transfer sheet being fed on a head surface by a platen roller, activating plural heating resistors according to the image data, and recording the image on the image receiving sheet, and a thermal head drive control means for transferring image data to the thermal head, includes:

- resistance measuring means and resistance abnormality determining means for measuring a resistance of heating resistors of the thermal head, comparing the measured resistance value with the predetermined reference value and the resistance values of the adjacent heating resistors of the thermal heads with each other, determining if the resistance value is abnormal based on the compared result;
- means for sensing printing defects;
- means for sensing if jamming of the dye transfer sheet or the image receiving sheet takes place by sensing rotation of a feed roll of the dye transfer sheet or the image receiving sheet or rotation of the platen roller;
- a micro switch located close to the feeding path of the dye transfer sheet or the image receiving sheet and sensing if the dye transfer sheet or the image receiving sheet is out by the micro switch;
- means for sensing if the dye transfer sheet or the image receiving sheet is out by sensing the feed roll of the dye transfer sheet or the image receiving sheet or the rotation of the platen roller;
- means for sensing the number of left images or used images on the dye transfer sheet, a protective layer transfer sheet, and the image receiving sheet.

This invention provides a photographing mechanism located in the photographing box and having means for lighting an object to be imaged, means for photographing the object illuminated by the lighting means, image processing means for receiving an image signal of the object generated by the photographing means, a thermal transfer printer for receiving an image signal and printing out the image based on the image signal, a money handling mechanism, and control means for controlling the lighting means, photographing means, image processing means, and thermal transfer printer based on a start signal sent from the money handling mechanism, the photographing mechanism including means for sensing the state of the photographing mechanism and means for notifying the sensed result, the sensing

means being composed of one or more of means for measuring a resistance of the thermal head, means for sensing a pattern in the printing direction, means for sensing if the dye transfer sheet or the image receiving sheet is out or jammed, means for sensing the number of left images or used images on the dye transfer sheet, the transparent projective layer transfer sheet or the image receiving sheet, means for sensing if the lighting means is burnt out, or means for sensing if changes are out in the money handling mechanism.

This invention is arranged to constantly or occasionally monitor troubles such as an abnormal increase of a resistance or breaking of heating resistors breaking of the thermal head of the thermal transfer printer, an abnormality of the printer like heat resistor breaking of thermal head, out of paper, out of film, jamming, out of changes if the printer applies to the photographing box, or burnt-out of a lighting lamp, and automatically senses such a trouble, if any trouble takes place, and report it to a remote place at a time when such a trouble takes place or periodically. If lots of pieces of information of the photographing boxes located in plural places are allowed to be collected at a business base station, it is possible to take a swift response to any failure or a proper measure to the sensed trouble.

Further, based on the periodical report about the operating condition of each photographing box, each photographing box is allowed to be minutely treated.

According to a third aspect of the invention, a thermal transfer recording apparatus located in the photographing box is composed of means for conveying a dye transfer sheet, means for conveying an image receiving sheet, a printing mechanism including a platen roller and a thermal head for heating plural heating resistors so as to form an image on the image receiving sheet, thus pressing the dye transfer sheet and the image receiving sheet between the platen roller and the thermal head so as to transfer a dye of a color layers provided on the dye transfer sheet to the image receiving sheet, a thermal head driving means for transferring the image data to the thermal head, and a sheet cutter for cutting the image receiving sheet at predetermined intervals. The thermal transfer recording apparatus is arranged to separate the sheet-cut portion from the image recording section by the partition provided with a slit through which the image receiving sheet is passed and to prevent dirt from being intruded from the sheet cut portion.

The thermal transfer recording apparatus arranged as above operates to prevent intrusion of paper dust brought about when cutting the image-printed image receiving sheet through the effect of the partition. Since the image recording section is structured to prevent dirt, it is possible to prevent the intrusion of the dirt from the outside to the image recording section.

According to a fourth aspect of the invention, in the thermal transfer printer composed of means for feeding a dye transfer sheet, means for feeding an image receiving sheet, a printing mechanism including a platen roller and a thermal head for heating plural heating resistors so as to form an image on the image receiving sheet, thus pressing the dye transfer sheet and the image receiving sheet between the platen roller and the thermal head so as to transfer a dye of a color layers provided on the dye transfer sheet to the image receiving sheet, and a thermal head drive means for at least a platen roller, and a thermal head for recording the image on the image receiving sheet by heating plural heating resistors according to the image data on the image receiving sheet, and further providing a printing mechanism for pressing the dye transfer sheet transferring the image data to the thermal head, an automatic layout mechanism for the photographing box is characterized by providing means for sensing if each heating resistor of the thermal head is abnormal so as to, if the abnormality is sensed, change a printing location of the image so that a desired image may be recorded by only a proper heating resistor.

The automatic layout mechanism arranged as above operates to change the printing location of an image in order to prevent the image printed by the heating resistors if one or more of the heating resistors of the thermal head has a larger resistance or are broken. Hence, after an abnormality takes place, the automatic layout mechanism enables to record a desired image with no change of density and no printing voids.

According to a fifth aspect of the invention, in the thermal transfer printer for the photographing box providing an image recording section having means for feeding a dye transfer sheet to be loaded, means for feeding a image receiving sheet to be loaded, a platen roller located on the way of the feeding path of the dye transfer sheet and the image receiving sheet, and a thermal head for pressing the dye transfer sheet and the image receiving sheet being fed on the surface of the platen roller, activating plural heating resistors according to the image data and recording an image on the image receiving sheet, the printer is characterized by allowing plural heat transfer sheets and heated transfer sheets to be respectively loaded, providing means for sensing if at least one of the dye transfer sheet and the image receiving sheet is out and means for automatically exchanging the dye transfer sheet and the image receiving sheet based on this sensed result.

The thermal transfer printer arranged as above operates to detect if the dye transfer sheet or the image receiving sheet is out and automatically exchange the dye transfer sheet or the image receiving sheet with the new one.

According to a further aspect of the invention, in the thermal transfer printer providing a image recording section having means for feeding a thermal transfer sheet to be loaded, means for feeding a image receiving sheet to be loaded, a platen roller located on the way of the feeding path of the thermal transfer sheet and the image receiving sheet, and a thermal head for pressing the thermal transfer sheet and the image receiving sheet being fed on the surface of the platen roller, activating plural heating resistors according to the image data and recording an image on the image receiving sheet.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view showing an overall arrangement of a photographing box according to an embodiment of the present invention;

FIG. **2** is a view showing an arrangement of a camera;

FIG. **3** is an explanatory view showing a photographing method done in case of a color image;

FIGS. **4**(*a*)–**4**(*b*) is an explanatory view showing a photographing method done in case of a color image;

FIGS. **5**(*a*)–**5**(*c*) is an explanatory view showing an image magnification;

FIGS. **6**(*a*)–**6**(*b*) is an explanatory view showing a filter for correcting sharpness;

FIG. **7** is an explanatory view showing an image layout;

FIG. **8** is an explanatory view showing tone correction;

FIG. **9** is an explanatory view showing a sublimation transfer mechanism;

FIG. **10** is an explanatory view showing a thermal head control circuit;

FIG. **11** is a view showing a circuit for measuring a resistance of a heating resistor included in the thermal head;

FIGS. **12**(*a*)–**12**(*b*) is an explanatory view showing a method for sensing jamming, executed in a thermal transfer printer;

FIGS. **13**(*a*)–**13**(*b*) is an explanatory view showing a film end of the thermal transfer printer;

FIGS. **14**(*a*)–**14**(*c*) is an explanatory view showing a paper end of the thermal transfer printer;

FIG. **15** is an explanatory view showing a photographing box;

FIG. **16** is a schematic diagram showing a thermal transfer recording apparatus according to an embodiment of the present invention;

FIG. **17** is a block diagram showing an automatic layout mechanism according to an embodiment of the present invention;

FIG. **18** is a block diagram showing a circuit for measuring a resistance provided in a circuit for sensing if the head is burnt out;

FIG. **19** is an explanatory view showing a location of a heating resistor in which an abnormality takes place;

FIG. **20** is a view showing a change of an image layout;

FIG. **21** is a view showing another change of an image layout;

FIG. **22** is a view showing another change of an image layout;

FIG. **23** is a schematic side view showing a thermal transfer printer according to an embodiment of the present invention;

FIG. **24** is a schematic plane view showing the thermal transfer printer;

FIGS. **25**(*a*)–**25**(*b*) is an explanatory view showing means for sensing if the dye transfer sheet is out;

FIGS. **26**(*a*)–**26**(*c*) is an explanatory view showing means for sensing if the image receiving sheet is out;

FIG. **27** is a schematic side view showing a thermal transfer printer according to another embodiment of the present invention; and

FIG. **28** is a schematic plane view showing the thermal transfer printer.

PREFERRED EMBODIMENTS OF THE PRESENT INVENTION

FIG. **1** shows an overall arrangement of a photographing box according to an embodiment of the present invention, in which a numeral **1** denotes a photographing box, a numeral **2** denotes a chair, a numeral **3** denotes a light, a numeral **4** denotes a camera, a numeral **5** denotes a monitor, a numeral **7** denotes a controller, a numeral **8** denotes a money handling machine, a numeral **9** denotes a thermal sublimation transfer printer, and a numeral **10** denotes a power supply.

The photographing box **1** is composed of a housing section for housing a photographing device and a photographing section where a chair or the like is located. In the box **1**, the photographing is allowed to be fundamentally done without man's hands.

In photographing an object, when a user gives a proper fee to the money handling machine **8** by cash or a pre-paid card, the money handling machine **8** operates to send a start signal to the controller **7**. In response to the start signal, the controller **7** starts to control the light **3**, the camera **4**, and the sublimation transfer printer **9**. Herein, the start signal is generated when a user pays for the photo. In place of the payment, the start signal may be generated by automatically sensing a figure entered into the photographing box through the effect of an optical sensor or by preparing a start switch to be pressed by a user entered in the photographing box. The power supply **10** operates to feed power to those components.

At first, the light **3** illuminates a person sitting on the chair **2** so that the person may be imaged by the camera **4**. For example, as shown in FIG. **2**, the camera **2** is composed of a CCD imaging element **11** and an analog-to-digital converter **12** built therein. The video signal from the CCD is directly analog-to-digital converted into a digital video signal. Herein, the method is used of directly analog-to-digital converting the signal from the CCD into digital video signal for suppressing the image degradation to a minimum. In place, another photographing device such as a commercially available video camera or still video camera may be used. The output video signal may be analog-to-digital converted into the digital signal by any proper means.

In photographing a color photo, as shown in FIG. **3**, the light incident to the imaging device is divided into a red component, a green component and a blue component through the effect of a dichroic mirror. For each of the light components, CCD photographing elements **11***a* to **11***c* are prepared for obtaining a video signal for each color light component. Alternately, as shown in FIG. **4**A, a mosaic color filter (or stripe filter) **14** is used for separating the image light into R, G and B light components at each pixel. The CCD photographing element **11** serves to obtain each of the R, G and B video signals from each light component as shown in FIG. **4**B.

The digital video signal from the camera **4** is received into the controller **7**. The controller **7** operates to control the devices and has some image processing functions such as image magnification, sharpness correction, color masking, image layout, or tone correction.

If the image data **D0**, **D1**, **D2**, **D3**, . . . , as shown in FIG. **5**A is obtained, the 50%-reduced image can be realized by thinning **D1**, **D3**, **D5**, . . . , that is, leaving the image date **D0**, **D2**, **D4**, ... Moreover, as shown in FIG. **5**C, the 200%-magnified image can be realized by interpolating **D0**, **D1**, **D2**, **D3**, . . . in a manner to form an image of **D0**, **D0**, **D1**, **D1**, **D2**, **D2**, **D3**, **D3**, ... The magnification may be set to any value. Any proper method may be used for creating the interpolated data.

The sharpness correction is a process for putting emphasis on the image contour. For example, the filters as shown in FIGS. **6**A and **6**B are used for adding the contour components extracted by the differentiation to an original image. The resulting image contains emphasized edges.

When the R, G and B signals obtained in the above process are output from a printer, it is necessary to do a process for converting the C, M and Y signals. For example, if the control is done at 256 tones,

$$\begin{pmatrix} C \\ M \\ Y \end{pmatrix} = 256 \times \begin{pmatrix} 1-r \\ 1-g \\ 1-b \end{pmatrix}$$

wherein r denotes a value regulated from the obtained R signal and g and b are values regulated in similar manners.

The color masking is a process for removing turbid components of color material for printing. For example, if C, M and Y are obtained as an image data to the printer, the following conversion is done for converting the C. M and Y

signals into such C', M' and Y' signals as cancelling the turbid components of the ink.

$$\begin{pmatrix} C' \\ M' \\ Y' \end{pmatrix} = \begin{pmatrix} a1 & a2 & a3 \\ b1 & b2 & b3 \\ c1 & c2 & c3 \end{pmatrix} \begin{pmatrix} C \\ M \\ Y \end{pmatrix}$$

In the above process, the conversion from the R, C and B signals to the C, M and Y signals and the color masking are independently executed. Both of the processes are executed one at a time.

The image layout is a process for arranging a printing layout if the image sized to a way of use obtained by the foregoing image magnification is output with multiple images being placed on one sheet as shown in FIG. **7**, concretely, for generating location data of one or more of four corners of each photo. In this case, the size of each photo is understood from the image magnification. Hence, the location data can be generated in a manner to allow the photos not to be overlapped with each other.

The tone correction is a process for changing a density tone (axis of abscissas) of 0 to 255 along the characteristics of γ**1** and γ**2** as shown in FIG. **8**. For the characteristic of γ**1**, a tone density is corrected for keeping a low density more definitive. For the characteristic of γ**2**, a tone density is corrected for keeping a high density more definitive.

The image data on which the above image process is done is transferred to the sublimation transfer printer **9** and then is printed out.

The printing mechanism of the sublimation transfer printer is as shown in FIG. **9**.

A thermal transfer sheet **21**, a heat resistive layer **21***a*, a base material **21***b*, and a dye layer **21***c* are laminated through a primer laid between the adjacent layers in a manner to keep the adhesion of a coating material onto the base material better. In place of the primer, a adhesion-processed film may be used. As a heat resistive layer **21***a*, a mixture of polyvinyl butyral, polyisocyanate and phosphate ester is used. As the base material **21***b*, polyethylene terephthalate or polyimide is used. As the dye layer **21***c*, a sublimable dye such as indoaniline system, pyrazolone system or azo system and a binder like cellulose system or polyvinylacetale system are used for composition.

An image-receiving sheet **22** is composed of an image-receiving layer **22***b* and a base material **22***b* laminated through a primer laid therebetween. The image-receiving layer **22** is made of saturated polyester or vinyl chloride. The base material **22***a* is composite paper, polyester foam or polypropylene foam. The back side layer is made of binder, lubricant or coating agent. In place, the vinyl chloride sheet itself may be used the image-receiving layer.

The image-receiving sheet **22** is wound around the platen roller **23**. On the sheet **22**, the thermal transfer sheet **21** is overlapped. The thermal head **24** comes into contact with the back of the thermal transfer sheet **21** for heating the thermal transfer sheet **21** so that the sublimable dye is heated for transferring it to the image-receiving layer **22***b*, that is, dyeing the layer **22***b*. The sublimation transfer device is arranged to transfer the corresponding amount of dye to the energy applied to the thermal head to the image-receiving layer. Hence, the tone according to the heat amount is allowed to be recorded at each pixel dot.

For example, if the silver photo system is used, the temperature change of the developing solution by 1 degree centigrade has a great impact on the image quality. It is therefore necessary to greatly pay for the temperature control. On the other hand, since the present embodiment uses the sublimation transfer recording system as described above, a slight temperature change does not have so much an impact on the image quality. Further, by sensing the environment temperature at a time and properly correcting the influence of temperature, a constant image quality is allowed to be kept over a wide range of temperature.

The image obtained as described above may be checked before it is printed out through the monitor **5**. If the user does not like the image displayed on the monitor **5**, the user may image the object again. Further, before printing out the object, the location and the composition of the object are allowed to be checked so that the person to be imaged may adjust the location and the construction by himself. At a time, another person may give an indication about the next operation to the person to be imaged as watching the monitor. Or, if any trouble takes place, it may be displayed on the monitor.

As described above, according to the present invention, the thermal sublimation transfer printer is used in the drying process. Hence, the image may be printed out at high speed. Moreover, it does not cost so much in implementing the photographing box. The implemented photographing box is easily maintained. Additional provision of the monitor makes it possible to image the object again by checking the presumable image before printing it out.

The aforementioned sublimation transfer color printer operates to control a tone (density) according to the times of pulses applied to the corresponding heating resistors of the thermal head, based on the 8-bit multivalued data for each pixel. The tone control will be roughly described with respect to FIG. **10**.

For example, the image data is input from an external device such as a host computer to an I/F **31** and then is written in a buffer memory **32**. The data written in the buffer memory **32** is read one line by one line in a thermal head control circuit **33** for comparing the data for each line with each value of 1 to 255 at each pixel. At first, the image data of each pixel is compared with "1". As for the image data which is equal to or larger than "1", a value of "1" is put into the location. As for the image data which is smaller than "1", a value of "0" is put into the location. One line composed of pixels is arranged as above. The pulse train as to the pixels on one line is output.

That is, the output from the thermal head control circuit **33** is arranged so that if the image date is equal to or larger than "1", the data location has a value of "1" and the other locations each have a value of "0". This pulse train is set to a shift register **41** included in a thermal head **34** on the controlled timing. The latch circuit **42** serves to latch the data in the shift register in response to a latch signal from the thermal head control circuit **33**. During the interval when an enable signal is fed to a gate circuit **43**, the heating resistors **44** located for the "1"-latched bits are selectively actuated so that they may be heated for recording the corresponding data. Next, the thermal head control circuit **33** serves to compare the transfer data with a value of "2".

As for the image data which is equal to or larger than "2", a value of "1" is put into the location. As for the image data which is smaller then "2", a value of "0" is put into the location. The control circuit **33** operates to output a pulse train as to one pixel line having such pixel values.

The pulse train from the control circuit **33** is set to the shift register on the controlled timing and then is latched by a latch circuit **42**. Like the above case, the heating resistors located for the bits having "1" of the bits included in the latch circuit **42** are actuated for recording the corresponding data. Later, until the compared value reaches the maximum image data "255", the similar operation is repeated. Then, printing out of one line is terminated.

The thermal head used in such a thermal transfer printer has a disadvantage as follows. That is, the heating resistors may have higher resistance or be broken by any possible cause while it is used. In this case, the density may be linearly made lower in the printing direction or the portion to be printed may not appear. Since the line type thermal head is used, for example, if one of the heaters is abnormal, a linear void may appear in the printing direction.

FIG. 11 is a view showing a resistance measuring circuit for detecting if the heater of the thermal head is abnormal.

The thermal head **100** provides a circuit for controllably driving plural ones or each one of the heating resistors. A driving power supply **113** feeds power to the thermal head **100** and is driven synchronously with a clock generated in a cloak generator **110**. A data generator **109** operates to generate such data as activating only one heating resistor and transfer it. The latch generator **110** operates to generate a latch signal for latching the data to be transferred to the thermal head. The heating resistors corresponding to the latched bits are selectively activated for heating during the period when an enable signal is fed by an enable signal generator **112**. The data generator **109**, the latch generator **111**, and the enable signal generator **112** are controlled by a resistance measurement control circuit **108** in sync with the clocks from the clock generator **110**.

A constant voltage is fed to the thermal head **100** through the VH and VL terminals from the constant voltage supply **101**. The current flowing through the heating resistor is measured by a current detector **102** and is amplified by a differential amplifier **103**. Then, the amplified current is adjusted to a predetermined current level by a level shift circuit **104**. The level-shifted signal is converted into a digital signal through the effect of an analog-to-digital converter **105** which is driven by a sampling timing signal from the resistance measurement control circuit **108** synchronized with clocks from the clock generator **110**. The digital signal is read by a buffer memory **106** so that it may be compared with a reference value pre-recorded in a ROM **107**.

Next, a method for measuring a resistance will be described. The data generator **109** operates to generate such data as activating just one heating resistor and transfer it to the thermal head **100**. The data Is latched by a latch signal from the latch generator 111, when only the object heating resistor is activated by giving an enable signal from the enable signal generator **112** to the thermal head **100**. The current flowing at this time is measured by the current detector **102**, amplified and adjusted to a proper level current. Then, the current is sampled and then is analog-to-digital converted into a digital signal. Then, the measured value is written in the buffer memory **106**. And, the data generator **109** operates to generate such data as activating each heating resistor in sequence. By writing each measured value at that time into the buffer memory **106** in sequence, the resistance of all the heating resistors are allowed to be measured.

Next, as to each heating resistor, it is checked

(1) if the measured value is made equal to or larger than a reference value pre-recorded in the ROM **107**, and

(2) if the measured value of each heating resistor is changed as compared with the measured value of the adjacent heating resistor by a predetermined value.

If any one of them is determined to be affirmative, an error is indicated on the monitor (not shown) or by an alarm.

In the foregoing description, a constant voltage is fed from the constant voltage source to the thermal head. Alternately, a constant current source may be used so that it may feed constant current to the thermal head and a voltage between the VH and VL terminals may be measured. Further, the power source for the measurement may be used with the power source for printing or another one may be prepared so that either one of the power sources may be switched for using it. The level shift may use a proper value according to the range of the resistance to be measured. The clock generator, the latch circuit, and the enable generator may be used with the circuit for printing. They may be independently prepared so that they may be switched in use.

As for the lower linear density or the voids of the image caused along the printing direction of the printed image by the breaking of the heating resistors of the thermal head, in the above measurement, the disadvantage may be checked on whether or not the measured value stays in the allowable range. Or, by installing the line sensor along the direction perpendicular to the printing direction and integrating density data in the printing direction, the disadvantage may be detected on the integrated value.

In turn, the description will be oriented to a method for sensing a paper-jamming state caused by adhesion of the image receiving sheet to the dye transfer sheet in the thermal transfer printer with reference to FIG.**12**.

FIG. **12A** shows the normal state of these sheets, in which a thermal transfer sheet **122** unwound out of a feed roll **120** is pressed against a thermal head **100** with an image receiving sheet **123** laid therebetween by means of a platen roller **124** and heated according to image data and the recorded sheet is wound around a take-up roll **121** in sequence.

At a time, as shown in FIG. **12B**, if the image receiving sheet is adhered by heat with the thermal transfer sheet, the sheet is not wound around the take-up roll **121** or the take-up roll lowers its rotation speed, thereby bringing about sheet jamming. If the jamming takes place as a result of adhesion of the image receiving sheet with the thermal transfer sheet, the platen roller is rotated, while the take-up roll **121** is not rotated or lowers its rotation speed. Hence, sheet jamming is sensed on the difference of the rotation speed between the platen roller and the take-up roll. Of course, it may be sensed from only the rotation speed of the take-up roll itself. If necessary, it may apply to jamming between a protective layer transfer sheet and the image receiving sheet.

FIG. **13** is an explanatory view showing how "out of thermal transfer sheet" is sensed in the thermal transfer printer.

As shown in FIG. **13A**, a micro switch **130** is located close to a feeding path of the thermal transfer sheet **122**. As the thermal transfer sheet is being consumed, the diameter of the roll film in the feed roll **120** is made smaller. Thus, the travel path is gradually changed upward. At the end of the thermal transfer sheet, as shown in FIG. **13B**, the thermal transfer sheet comes into contact with the micro switch for sensing "out of thermal transfer sheet".

FIG. **14** is an explanatory view showing how "out of thermal transfer sheet" is sensed in the thermal transfer printer.

In the normal state, as shown in FIG. **14A**, the image receiving sheet is unwound from the feed roll so that the sheet may be pressed against the thermal head (not shown) with the dye transfer sheet (not shown) being overlapped therewith by the platen roller. When the image receiving sheet weakly adheres to a bobbin, if the sheet is out, the sheet is separated from the feed roll **125** as shown in FIG. **14B**. As a result, no sheet is left around the feed roll **125**, so that the feed roll **125** serves to stop its rotation while only the platen operates to rotate. When the image receiving sheet strongly adheres to the bobbin, if the sheet is out, the feed roll is

constricted and stops its rotation while only the platen operates to rotate. Hence, by monitoring the rotations of both the roll and the platen, it is possible to detect that the image receiving sheet is out. Of course, by monitoring only the rotation of the feed roll **125**, it is possible to detect that the image receiving sheet is out.

FIG. **13** concerns the dye transfer sheet and FIG. **14** concerns the image receiving sheet. The sensing method may apply to both of the dye transfer sheet and the image receiving sheet. Further, it may similarly apply to the protective layer transfer sheet.

As another method, to know the number of unused frames about the dye transfer sheet, the protective layer transfer sheet and the image receiving sheet, it is possible to take the steps of setting an input number of sheets to the counter when loading the sheets, decrement a count value each time one image is printed or detect a mark standing for a number of unused frames, the mark expressed on the sheet side at each one screen or at each constant number of screens, and decrementing the count value based on the sensed mark. Further, to know the number of used sheets, by incrementing the count value each time one image is printed out or sensing the mark standing for the left frames, the mark being attached on the sheet side, the used sheets can be grasped from the put number of images and the sensed number of left images.

Further, the rotation speed of the feed roll given when the sheet is unwound at a constant speed is sensed by a rotary encoder. In place, the roll diameter may be calculated from the rotation speed of the roll so as to estimate the left images or the used images.

FIG. **15** is an explanatory view showing a system for sensing some troubles such as a printer trouble, a burnt-out of a lighting lamp, or out of change in the money handling machine, occurring in the thermal transfer printer located in the photographing box shown in FIG.1 and notifying the user of the sensed trouble.

If the thermal transfer printer is located in the photographing box, the controller **145** is located for controlling the overall photographing. Hence, with the foregoing method, it is possible to detect printer troubles such as an increased resistance or breaking the heating resistors of thermal head, out of sheets (image receiving sheet), out of films (dye transfer sheet), or jamming, read the sensed data in the controller, and notifying the monitoring side of the trouble.

Further, the controller **145** is connected to the money handling machine, the lighting lamp or the camera other than the printer. Hence, such a trouble may be sensed by a method for sensing if the changes are not left in the money handling machine by referring to the weight or for sensing the burnt-out of the lighting lamp by measuring the resistance. The sensed trouble is read in the controller and then is notified to the monitoring side.

As a method for sensing a burnt-out of the lighting lamp, by referring to the luminance data of the background obtained by photographing the object, if the luminance data is smaller than the set reference value, the burnt-out is sensed. Or, when the luminance data of the background at the previous photographing is stored in the memory, the stored luminance data is compared with the luminance data of the background of the photographed image, if the present read luminance data is lower than the value stored in the memory by a predetermined value, the burn-out is determined. In place, a light intensity sensor for measuring an intensity of light when photographing an object in the photographing space is provided for sensing if the lamp is burnt out.

In FIG. **15**, the controller **145** for controlling the overall photographing system in the photographing box **140** may be connected to a modem **150**. If any trouble takes place in any place in the photographing system, the trouble information is sent out from the controller **145** to a phone line **152** or through a radio machine **151**. The trouble information sent out to the phone line **152** is read into a host machine **154** through the modem **153**. Or, the trouble information sent out of the radio machine **151** is received by another radio machine **155** from which the information is read into the host machine **154**.

In addition to giving a report about a trouble in the photographing box, it is possible to periodically report the used (sold) frames of the dye transfer sheet, the protective layer transfer sheet and the image receiving sheet or the number of left frames. Further, the informations in plural photographing boxes may be collected in a business station having the host machine located therein through the effect of the notice system.

As described above, the present invention enables to automatically monitor troubles such as an abnormal resistance of heating resistor of the thermal head, break of the thermal head, out of sheets, out of films, paper jamming, out of changes to be caused if the thermal transfer printer applies to a photographing box, and a burnt-out of the lighting lamp, so that the invention may rapidly and properly cope with those troubles.

In particular, if the thermal transfer printer is located in a self-service photographing box, any trouble can be grasped by a business station having a host machine located therein at a time when the trouble has occurred. Further, the invention may more minutely cope with the trouble by creating a failure occurrence real-time list or an individual failure history. Since the sold number of the pictures are easily grasped, the materials may be effectively supplemented to the frequently-used photographing box. Moreover, since the number of left images in the photographing box are easily grasped, it is possible to effectively make a schedule for supplementing proper materials or dispatch the persons through an efficient route, thereby suppressing the labor expenses consumed by the maintenance to a minimum.

FIG. **16** is a schematic view showing a thermal transfer recording apparatus according to another embodiment of the present invention.

In FIG. **16**, a numeral **201** denotes a platen roller. A numeral **202** denotes a thermal head located as opposed to the platen roller **201**. A numeral **203** denotes a dye transfer sheet or a thermal transfer sheet to be unwound from a feed roll **231** and to be wound around a take-up roll **232**. A numeral **204** denotes a image receiving sheet to be unwound from a roll **241**. The dye transfer sheet **203** and the image receiving sheet **204** are loaded in a manner to be passed between the platen roller **201** and the thermal head **202**, both of which are components of a printing mechanism. The thermal head **202** presses the dye transfer sheet **203** against the image receiving sheet **204**, in which state the platen roller **201** is rotated for feeding the image receiving sheet **204** and the dye transfer sheet **203**.

The image data is transferred from the thermal head driving means (not shown) to the thermal head **202** in sync with a feed speed of the image receiving sheet **204** so that plural heating resistors may be activated according to the image data. The dye contained in the dye layer formed on the dye transfer sheet **203** is transferred on the image receiving sheet **204** for recording the image on the image receiving sheet **204**. The image receiving sheet **204** printed by the

printing mechanism is fed out between a pair of opposed sheet cutters **205** with the sheet **204** being laid between a pair of nip rollers **242** and **243** so that the sheet may be cut out at predetermined intervals.

The overall recording apparatus is held in a case **206**. This case **206** comes into contact with the outside of the nip rollers **242** and **243**. The case **206** is separated into a sheet-cut section A and an image recording section B corresponding to the other portion by a partition **261** provided with a slit a through which the image receiving sheet **204** is passed. On the cover for covering the sheet cut portion A of the case **206**, a paper ejecting slit **262** is provided. The image receiving sheet **204** cut by the sheet cutter **205** is ejected out of the slit **262**. On the portion for covering the image recording section B, a filter **263** is provided. A fan **264** is installed inside of the image recording section B for cooling down the image recording section B and preventing intrusion of dirt from the outside into the image recording section B.

When the image is recorded by this recording apparatus, paper dust appears when the image receiving sheet **204** after the image is printed is cut by the sheet cutters **205**. The paper dust is screened by the partition **261** so that the almost all of paper dust stays in the sheet cut portion A without being directly intruded to the image recording section B. Since the image recording section **13** has a dust-preventing structure, the dirt from the outside is not intruded into the image recording section B. Hence, no paper dust or dirt adheres to the thermal head **201** of the image recording section B, the platen roller **202**, the dye transfer sheet **203**, and the image receiving sheet **204** when recording an image.

As described above, the thermal transfer recording apparatus according to the present invention is separated into the sheet-cut portion and the image recording section by the partition having a slit through which the image receiving sheet is passed. Further, since the image recording section has a dust-preventing structure, no dust paper appearing in the sheet-cut portion or no dirt from the outside is intruded into the image recording section. This makes it possible to prevent defective printing or printer failure.

FIG. **17** is a block diagram showing an automatic layout mechanism according to the present invention, which operates to change a layout for coping with an abnormal state of the thermal head. As is understood from the comparison between the present invention and the prior art shown in FIG. **10**, there are provided a sensor for thermal head breaking **315**, an image processing circuit **316** and a printing mechanism control circuit **317** in addition to an I/F **311**, a buffer memory **312**, a thermal head control circuit **313**, and a thermal head **314** as included in the prior art.

The sensor for thermal head breaking **315** provides a resistance measuring means and an abnormal resistance determining means for measuring a resistance of each heating resistor included in the thermal head. By comparing the measured resistance with a predetermined reference value and the resistances of the adjacent heating resistors with each other, an abnormal state is sensed on the compared result. A location of the heating resistor in which an abnormal state takes place is reported to the image processing circuit **316**. FIG. **18** shows a resistance measuring circuit included in the sensor for thermal head breaking **315**.

The thermal head **400** contains a circuit for driving and controlling plural ones or each one of the heating resistors. The thermal head **400** is powered by a driving power supply **413** so that the thermal head **400** is driven in synchronous with clocks generated in a clock generator **410**. A data generator **409** operates to generate such data as heating just one heating resistor and transfer the data to the thermal head **400**. A latch generator **411** serves to generate a latch signal for latching data to be transferred to the thermal head. The heating resistor for the latched bit is selectively driven and heated during the period when an enable signal is given from an enable signal generator **412**. The data generator **409**, the latch generator **411** and the enable signal generator **412** are controlled by a resistance measuring control circuit **408** in synch with the clocks generated in the clock generator **410**.

A constant voltage supply **401** operates to supply a constant voltage to the thermal head **400** at the VH and VL terminals. The current flowing through a heating resistor is measured by a current detector **402** and is amplified by a differential amplifier **403**. The amplified current is adjusted to a predetermined current level by a level shift circuit **404**. The level-shifted signal is converted into a digital signal through the effect of an analog-to-digital converter **405** which is driven in response to a sampling timing signal from the resistance measurement control circuit **408** synchronized with the clocks generated by the clock generator **410**. The digital signal is read by a buffer memory **406** and is compared with a reference value pre-recorded in a ROM **407**. The resistance is measured as follows. At first, the data generator **409** operates to generate such data as heating just one heating resistor and transfer the data to the thermal head **400**. The latch signal from the latch generator **411** is used for latching the data transferred to the thermal head **400**. At a time, the enable signal from the enable signal generator **412** is fed to the thermal head **400** for activating only the necessary heating resistors. The current flowing at this time is measured by the current detector **402**, amplified and level-adjusted. The level-shifted current is sampled and converted into a digital signal. The digital signal is written in the buffer memory **406**. Then, the data generator **409** serves to sequentially generate such data as activating each heating resistor. The measured value of each activated heating resistor is sequentially written in the buffer memory **406** for measuring the resistances of all the heating resistors.

Next, as to each heating resistor, it is checked

(1) if the actual measured value is compared with the reference value recorded in the ROM **407** and the actual measured value is changed as compared with the reference value by a predetermined value or more, and

(2) if the actual measured value of a heating resistor is compared with that of the adjacent heating resistor and the former is changed as compared with the latter by a predetermined value or more.

If any one of them is determined to be affirmative, it is determined that an abnormal state takes place in the heating resistor. Then, a head breaking signal is input to the image processing circuit **316** shown in FIG. **17**.

In the foregoing description, the constant voltage supply operates to supply a constant voltage to the thermal head. In place, a constant current supply may be used for feeding constant current for measuring the voltage applied between the VH and VL terminals. Further, the power supply for measurement is used with the power supply for printing. Or, another power supply may be prepared so as to switch to a proper power supply. Further, for shifting the current level, a proper value is selected in the range of the resistances to be measured. In addition, the clock generator, the latch circuit and the enable signal generator may be used with those for printing. They may be prepared dedicatedly for the thermal head and switchably used.

The signal for sensing a head breaking is applied to the image processing circuit **316**, in which the layout to be printed most efficiently is allowed to be calculated without

using the abnormal heating resistor. The image signal based on the layout is input to the buffer memory **312**. At a time, the printing control signal based on the layout is input to a printing mechanism control circuit **317** for changing controls of a motor for the dye transfer sheet and the platen roller. In place, it is possible to use a method for returning the signal for sensing head breaking from the head breaking sensing circuit **315** to the host computer through the I/F **311**.

Next, the description will be oriented to a change of a layout in the case of printing a combination of four certificate photos consisting of 2×2 frames at the four printing locations a**1** to a**4**. If the abnormal heating resistor appears at the location close to a non-printing area between the two frames ranged in the width direction of the image receiving sheet as shown by (1) of FIG. **19**, for example, the print area is shifted to the left in a manner to allow the abnormal heating resistor to shift to the non-printing area between the images as keeping a matrix consisting of 2×2 frames and print the images at the locations b1 to b**4**. If the abnormal heating resistor takes place at a place separated from the non-printing area as shown by (2) of FIG. **19**, as shown in FIG. **21**, the frames are rearranged as a matrix consisting of 4×1 frames as shown in FIG. **21** and are printed at the left-hand locations c**1** to c**4**.

If the abnormal heating resistor takes place at the location indicated by (3) of FIG. **19**, the frames are rearranged as a matrix consisting of 1×4 frames as shown in FIG. **22** and are printed at the right-hand locations d**1** to d**4**. In a case that an abnormal state takes place at the location indicated by (2) (or (3)) of FIG. **19**, when the feeding length per one color of the dye transfer sheet corresponds to two frames as shown by L of FIG. **20**, after forming the images at the locations c**1** and c**2** of FIG. **21** (or d1 and d2 of FIG. **22**), the printing mechanism control circuit is functioned to form the images at the locations c**3** and c**4** (or d**3** and d4 of FIG. **22**) without ejecting the image receiving sheet. By changing the printed locations, the portions along the printing direction of the abnormal heating resistor are removed from the image portions. Hence, the desired images are allowed to be recorded.

As described above, according to the present invention, if an abnormal state takes place in the thermal head of the thermal transfer printer, the image layout is changed in a manner to activate only proper heating resistors to record images without using the abnormal heating resistor. Hence, if an abnormal state takes place, desired images are allowed to be serially recorded. Hence, the consumption of the dye transfer sheet and the image receiving sheet may be suppressed to a minimum. In particular, if the thermal transfer printer is located in a self-service photographing box, the present invention makes great contribution to avoiding a user's claim for a defective print.

FIG. **23** is a schematic side view showing a thermal transfer printer according to another embodiment of the present invention. This printer provides a capability of taking measures of an "out of material" state. FIG. **24** is a schematic plan view showing the printer.

As shown in FIGS. **23** and **24**, a thermal head **502** of a recording section **501** is located as opposed to a platen roller **503**. A dye transfer sheet **504** and an image receiving sheet **505** are loaded in a manner to allow these sheets to be passed between the thermal head **502** and the platen roller **503**. The image receiving sheet **505** is pressed on the thermal head **502** with the dye transfer sheet **504** laid therebetween, in which state the platen roller **503** is rotated to feed the dye transfer sheet **505** and the image receiving sheet **504**. Energy is applied to the thermal head **502** in sync with the feeding speed of the image receiving sheet **505**. The thermal head **502** serves to activate plural heating resistors according to the image data so that the image may be recorded on the image receiving sheet **505**. A pair of cutters **506** operate to cut the printed sheet **505** at predetermined intervals and eject the cut sheet portions.

The dye transfer sheet **504** is held in a cassette case **509** in the state that the sheet **504** is tensed around a feed roll **507** and a take-up roll **508**. Two cassette cases **509***a* and **509***b* are loaded to an A location and a B location as shown in FIG. **23** as being set to an exchanging means (not shown). These cassette cases are supported in a manner to be movable between the recording location for the recording section **501** and the waiting location located on the side of the recording section **501**. That is, the exchanging means of the dye transfer sheet **504** operates to reciprocate one cassette case **509***a* between the A and the C locations, while it operates to reciprocate the other cassette case **509***b* between the B location and the A location as being interlocked with the reciprocation of the cassette **509***a*.

The image receiving sheet **505** is wound around a bobbin **510**. Two rolls **511***a* and **511***b* are loaded to the printer. As viewed in FIG. **23**, the image receiving sheet **505** is unwound from the lower roll **511***a* and is used for recording an image, while the image receiving sheet **505** wound around the upper roll **511***b* is in the waiting state. That is, the image receiving sheet **505** is slightly unwound from the upper roll **511***b*. The tip of the image receiving sheet **505** is set to an exchange plate **513** through a nip roller **512**.

FIG. **25** is an explanatory view showing means for sensing if the dye transfer sheet **504** (material) is out. As shown in FIG. **25**A, a micro switch **514** is located close to a feeding path of the dye transfer sheet **504**. As the dye transfer sheet **504** is being consumed, the diameter of the feed roll **507** is made smaller, thereby slightly displacing the feeding path toward the upward. At the end of the roll, the dye transfer sheet **504** comes into contact with the micro switch **514** as shown in FIG.**25**B for sensing that the dye transfer sheet **504** is out.

FIG. **26** is an explanatory view showing means for sensing if the image receiving sheet **505** is out. In the normal time, as shown in FIG. **26**A, the image receiving sheet **505** together with the dye transfer sheet (not shown) is unwound from the roll **511** so that the image receiving sheet **505** is pressed on the thermal head by the platen roller **503**. If the image receiving sheet **505** weakly adheres to the bobbin **510**, at the end of the roll, the image receiving sheet **505** is separated from the bobbin **510** as shown in FIG. **26**B. Hence, the bobbin **510** becomes idle and stops its rotation. Only the platen roller **503** is rotated. If the image receiving sheet **505** strongly adheres to the bobbin **510**, at the end of the roll, the bobbin **510** is constrained and stops its rotation as shown in FIG. **26**C. This results in leaving only the platen roller **503** rotated. In any case of weak adherence and strong adherence, the rotation of the bobbin **510** is stopped and only the platen roller **503** is rotated. By monitoring both of the rotations, it is possible to sense that the image receiving sheet **505** is out. Alternately, by monitoring only the rotation of the bobbin **510**, it is possible to sense that the material is out.

FIG. **25** shows means for sensing "out of material" of the dye transfer sheet **504**. FIG. **26** shows means for sensing "out of material" of the image receiving sheet **505**. Any one of the sensing means may apply to the dye transfer sheet **504** or the image receiving sheet **505**. In place, by counting the number of the used frames of the dye transfer sheet **504** or the image receiving sheet **505** or sensing an end mark

attached on the dye transfer sheet **504** or the image receiving sheet **505**, the "out of material" about each of the sheets is allowed to be sensed.

The exchange of the dye transfer sheet **504** or the image receiving sheet **505** is executed by sensing complete or substantial "out of material" about each of these sheets. In this case, both are not required to be exchanged at a time. If the exchange of both of the sheets **504** and **505** is constantly done at a time, it is possible to provide means for sensing if the material is out for either one of the dye transfer sheet **504** and the image receiving sheet **505**.

Next, when sensing the material is used up (out), the spontaneous exchange of the dye transfer sheet **504** and the image receiving sheet **505** will be described below.

When the image is recorded in the state as shown in FIGS. **23** and **24** and it is sensed that the dye transfer sheet **504** or the image receiving sheet **505** is used up (out), the exchanging means of the dye transfer sheet **504** is driven in response to the sensed result. The used cassette case **509**A located at the A location is moved to the C location. The cassette case **509**B located at the B location is moved to the A location. At a time, the left part of the image receiving sheet **505** in the roll **511***a* is wound around the bobbin **510** or fed out. Then, the nip rollers **512** operate to unwind the image receiving sheet **505** from the roll **511***b*. With the material exchanged by the above operation, the image printing is allowed to be continued. At each periodic checking time, the cassette case **509**A at the C location and the lower roll **511***a* are exchanged with the new ones.

After the image printing is proceeded further in this state, it is sensed that the dye transfer sheet **504** or the image receiving sheet **505** is used up, the used-up cassette case **509***b* located at the A location is moved to the B location and a new cassette case located at the C location is moved to the A location. At a time, the image receiving sheet is unwound from the new roll so that the exchanged material is used for the further printing. At each periodic checking time, the cassette case located at the B location and the upper roll **511***b* are exchanged with the new ones. The repetition of this cycle makes it possible to continue the printing with the materials being continuously fed.

FIG. **27** is a schematic side view showing a thermal transfer printer according to another embodiment of the present invention. FIG. **28** is a schematic plane view showing the printer.

Like the previously described embodiment, the printer of this embodiment uses the dye transfer sheet **504** housed in the cassette case **509**. Two such cassette cases **509***a* and **509***b* are loaded. As the image receiving sheet **505**, there is used a leaf-like sheet integrated in a stacker **515**. Two stackers **515***a* and **515***b* are loaded to the D and the F locations as shown in FIG. **28** in the state that they are set to the exchanging means (not shown). The stackers are supported in a manner to allow each of the stackers to reciprocate between the recording location for the recording section and the waiting location on the side of the recording section **501**.

That is, the exchanging means of the image receiving sheet **505** allows one stacker **515***a* to reciprocate between the D and the E locations, while the exchanging means allows the other stacker **515***b* to reciprocate between the E and the D locations as being interlocked with the reciprocation of the stacker **515***a*. Then, the means for sensing that the dye transfer sheet **504** is used up is the same as the above means. The method for sensing that the image receiving sheet **505** is used up is executed by sensing if the sheet in the stacker **515** is left through the effect of a passing sensor.

In this embodiment, the exchange of the dye transfer sheet **504** and the image receiving sheet **505** is executed by sensing that the material is completely or substantially out by the sensing means provided for each of the sheet. In this case, like the previous embodiment, it is not necessary to exchange both of the sheets with each other at a time. If the exchanges of the dye transfer sheet **504** and the image receiving sheet **505** are constantly executed at a time, it is also possible to provide means for sensing that the material is out for either one of the dye transfer sheet **504** and the image receiving sheet **505**.

The description will be oriented to the spontaneous exchanges of the dye transfer sheet **504** and the image receiving sheet **505** when sensing the material is out.

In the states shown in FIGS. **27** and **28**, the image is recorded. If it is sensed that the dye transfer sheet **504** or the image receiving sheet **505** is used up, the means for exchanging the dye transfer sheet **504** is driven so that the used-up cassette case **509***a* located at the A location is moved to the C location and the cassette case **509***b* located at the B location is moved to the A location. At a time, the exchanging means of the image receiving sheet **505** is driven so that the used-up stacker **515***a* located at the D location is moved to the F location and the stacker **515***b* located at the E location is moved to the D location. With the material exchanged by such an operation, the printing is continued. At each periodic checking time, the cassette case **509***a* located at the C location is replaced with the new one and the image receiving sheet **505** is filled in the stacker **515***a* located at the F location.

When the printing is proceeded in this state and it is sensed that the dye transfer sheet **504** or the image receiving sheet **505** is used up, the used-up cassette case **509** located at the A location is moved to the B location and the new cassette case located at the C location is moved to the A location, while the stacker **515***b* located at the D location is moved to the E location and the sheet-filled stacker **515***a* located at the F location is moved to the D location With the exchanged materials, the printing is proceeded. At each periodic checking time, the cassette case **509***b* located at the B location is replaced with the new one and the image receiving sheet is filled in the stacker **515***b* located at the E location. By repeating this cycle, the printing is continued as the material is continuously being fed.

As described above, the thermal transfer printer according to the present invention is arranged to load plural heat transfer sheets and plural heated transfer sheets and provide means for sensing if at least one of both of the sheets is out and means for automatically exchanging the dye transfer sheet and the image receiving sheet based on the sensed result. If, therefore, the dye transfer sheet or image receiving sheet is used up while the image is being recorded on the sheet, the printer operates to automatically exchange the materials with the new ones on the sensed result, thereby allowing the material to be continuously fed for proceeding the printing. In particular, in the self-service system for printing an image, the maintenance load is reduced, thereby making the promoting cost of the system lower as well.

What is claimed is:

1. A photographing box comprising:

a photographing mechanism house section for housing a photographing mechanism and a photographing space, said photographing mechanism having lighting means for illuminating an object to be imaged,

photographing means for photographing said object to be illuminated by said lighting means, image processing means for receiving an image datum of said object

given by said photographing means and providing at least an image magnifying function, an image reducing function, and an image layout processing function,

a sublimation transfer printer for receiving image data from said processing means and printing out a processed object image, said sublimation transfer printer comprising

means for feeding a dye transfer sheet and an image receiving sheet respectively,

a thermal head composed of plural heating resistors and operated to press said dye transfer sheet and said image receiving sheet being fed on the surface thereof by a platen roller and activate said heating resistors selectively according to image data for recording the image on said image receiving sheet,

a thermal head driving control means for transferring image data to said thermal head,

means for determining if the resistances are abnormal, said measured resistance being compared with a predetermined value and both of the measured values of the adjacent heating resistors, for determining if the resistance is abnormal on the compared result, and

control means for controlling said lighting means, said photographing means, said image processing means, and said sublimation transfer printer based on a start signal.

2. A photographing box as claimed in claim 1, further comprising a monitor for displaying an image of said object.

3. A photographing box as claimed in claim 1, further comprising a money handling mechanism for generating said start signal.

4. A photographing box as claimed in claim 4, wherein said feeding means operate to also feed a protective layer transfer sheet.

5. A photographing box comprising:

a photographing mechanism house section for housing a photographing mechanism and a photographing space, said photographing mechanism having lighting means for illuminating an object to be imaged,

photographing means for photographing said object to be illuminated by said lighting means, image processing means for receiving an image datum of said object given by said photographing means and providing at least an image magnifying function, an image reducing function, and an image layout processing function,

a sublimation transfer printer for receiving image data from said processing means and printing out a processed object image, said sublimation transfer printer comprising

means for feeding a dye transfer sheet and an image receiving sheet respectively,

a thermal head composed of plural heating resistors and operated to press said dye transfer sheet and said image receiving sheet being fed on the surface thereof by a platen roller and to activate the heating resistors selectively according to image data for recording the image on said image receiving sheet,

thermal head driving control means for transferring image data to said thermal head, and

means for detecting the number of unused frames or used frames of said dye transfer sheet, said protective layer transfer sheet, and said image receiving sheet, and

control means for controlling said lighting means, said photographing means, said image processing means, and said sublimation transfer printer based on a start signal.

6. A photographing box comprising:

a photographing mechanism house section for housing a photographing mechanism and a photographing space, said photographing mechanism having lighting means for illuminating an object to be imaged,

photographing means for photographing said object to be illuminated by said lighting means, image processing means for receiving an image datum of said object given by said photographing means and providing at least an image magnifying function, an image reducing function, and an image layout processing function,

a sublimation transfer printer for receiving image data from said processing means and printing out a processed object image, said sublimation transfer printer comprising

means for feeding a dye transfer sheet and an image receiving sheet respectively,

a printing mechanism having at least a platen roller and thermal head, said thermal head being composed of plural heating resistors to be selectively actuated according to the image data for recording the image on said image receiving sheet, and arranged to allow said dye transfer sheet and said image receiving sheet to be pressed between said platen roller and said thermal head and transfer a dye contained in a dye layer provided on said dye transfer sheet onto said image receiving sheet,

thermal head driving means for transferring image data to said thermal head, and

means for detecting an abnormal state of each heating resistor of said thermal head and operating to change a printing location of the image for activating only the proper heating resistors for recording the desired image, and

control means for controlling said lighting means, said photographing means, said image processing means, and said sublimation transfer printer based on a start signal.

7. A photographing box comprising:

a photographing mechanism house section for housing a photographing mechanism and a photographing space, said photographing mechanism having lighting means for illuminating an object to be imaged,

photographing means for photographing said object to be illuminated by said lighting means, image processing means for receiving an image datum of said object given by said photographing means and providing at least an image magnifying function, an image reducing function, and an image layout processing function,

a sublimation transfer printer for receiving image data from said processing means and printing out a processed object image, said sublimation transfer printer comprising

means for feeding a dye transfer sheet and an image receiving sheet respectively,

a thermal head composed of heating resistors and operated to press said dye transfer sheet and said image receiving sheet on the surface thereof by a platen roller and activate plural heating resistors selectively according to image data for recording the image on said image receiving sheet,

thermal head driving control means for transferring image data to said thermal head, and

jamming detecting means for detecting jamming of said dye transfer sheet or said image receiving sheet, wherein said jamming detecting means operates to

detect rotations of a take-up roll of said dye transfer sheet or said image receiving sheet and a rotation of said platen roller, and

control means for controlling said lighting means, said photographing means, said image processing means, and said sublimation transfer printer based on a start signal.

8. A thermal transfer printer having means for feeding a thermal transfer sheet and an image receiving sheet respectively, a thermal head composed of plural heating resistors to be selectively activated according to image data in the state of forcing said thermal transfer sheet and said image receiving sheet to be pressed on the surface of said thermal head by a platen roller, and thermal head driving control means for transferring image data to said thermal head, comprising:

means for detecting if said dye transfer sheet or said image receiving sheet is jammed by detecting the rotations of a take-up roll of said dye transfer sheet or said image receiving sheet and said platen roller.

9. A photographing box comprising:

a photographing mechanism house section for housing a photographing mechanism and a photographing space, said photographing mechanism having lighting means for illuminating an object to be imaged,

photographing means for photographing said object to be illuminated by said lighting means, image processing means for receiving an image datum of said object given by said photographing means and providing at least an image magnifying function, an image reducing function, and an image layout processing function,

a sublimation transfer printer for receiving image data from said processing means and printing out a processed object image, said sublimation transfer printer comprising

means for feeding a dye transfer sheet and an image receiving sheet respectively,

a thermal head composed of plural heating resistors and operated to press said dye transfer sheet and said image receiving sheet being fed on the surface thereof and to activate the heating resistors selectively according to image data for recording the image on said image receiving sheet,

thermal head driving control means for transferring image data to said thermal head, and

means for detecting when said dye transfer sheet or said image receiving sheet is used up by detecting rotations of the feed roll of said dye transfer sheet or said image receiving sheet and said platen rollers, and

control means for controlling said lighting means, said photographing means, said image processing means, and said sublimation transfer printer based on a start signal.

10. A thermal transfer printer having means for feeding a thermal transfer sheet and an image receiving sheet respectively, a thermal head composed of plural heating resistors to be selectively activated according to image data for recording the image on said image receiving sheet in the state of forcing said thermal transfer sheet and said image receiving sheet being fed to be pressed on the surface of said thermal head, and thermal head driving control means for transferring image data to said thermal head, comprising:

means for detecting when said thermal transfer sheet or said image receiving sheet is out by detecting the rotation of a feed roll of said dye transfer sheet or said image receiving sheet and the rotation of said platen roller.

11. A thermal transfer printer having means for feeding a thermal transfer sheet and an image receiving sheet respectively, a thermal head composed of plural heating resistors to be selectively activated according to image data for recording the image on said image receiving sheet in the state of forcing said thermal transfer sheet and said image receiving sheet to be pressed on the surface of said thermal head by a platen roller, and thermal head driving control means for transferring image data to said thermal head, comprising:

means for detecting the number of unused frames or used frames of said dye transfer sheet, said protective layer transfer sheet, and said image receiving sheet.

12. A thermal transfer printer having a printing mechanism composed of means for feeding a thermal transfer sheet and an image receiving sheet respectively, a thermal head composed of plural heating resistors to be selectively activated for recording the image on said image receiving sheet in the state of forcing said dye transfer sheet and said image receiving sheet to be pressed on the surface of said thermal head by a platen roller, said printing mechanism serving to print a color material of a color material layer formed on said dye transfer sheet, and thermal head driving means for transferring image data to said thermal head, comprising:

means for detecting an abnormal state of each heating resistor of said thermal head, if an abnormality is detected, the printing location of said image being changed in a manner to record said image by only properly functional heating resistors.

* * * * *

US005493409A

United States Patent [19]

Maeda et al.

[11] Patent Number: 5,493,409

[45] Date of Patent: Feb. 20, 1996

[54] **STILL VIDEO CAMERA HAVING A PRINTER CAPABLE OF PRINTING A PHOTOGRAPHED IMAGE IN A PLURALITY OF PRINTING MODES**

[75] Inventors: **Yutaka Maeda**, Kanagawa; **Yasuhiro Kyoden**, Sagamihara; **Hirokazu Naruto**, Higashiosaka; **Yoshito Tanaka**; **Dai Shintani**, both of Sakai; **Katsuyuki Nanba**, Osakasayama, all of Japan

[73] Assignee: **Minolta Camera Kabushiki Kaisha**, Osaka, Japan

[21] Appl. No.: **324,365**

[22] Filed: **Oct. 14, 1994**

Related U.S. Application Data

[63] Continuation of Ser. No. 800,584, Nov. 27, 1991, abandoned.

[30] **Foreign Application Priority Data**

Nov. 29, 1990	[JP]	Japan	2-334687
Nov. 29, 1990	[JP]	Japan	2-334688
Nov. 29, 1990	[JP]	Japan	2-334689
Nov. 29, 1990	[JP]	Japan	2-334690
Nov. 29, 1990	[JP]	Japan	2-334691
Nov. 29, 1990	[JP]	Japan	2-334692
Nov. 29, 1990	[JP]	Japan	2-334693
Nov. 29, 1990	[JP]	Japan	2-334694

[51] **Int. Cl.**[6] **H04N 1/23**; G01D 15/10; G03B 27/52; G03B 29/00

[52] **U.S. Cl.** **358/296**; 358/909.1; 358/503; 347/218; 355/21; 354/76

[58] **Field of Search** ..... 358/296, 909.1, 358/209, 213.11, 213.23, 229, 41–44, 47, 48, 500, 503, 406, 436, 439, 442, 473; 346/25, 76 PH, 134; 354/3, 75, 76; 355/18, 19, 21, 27, 44, 45; 347/3, 215, 218, 264

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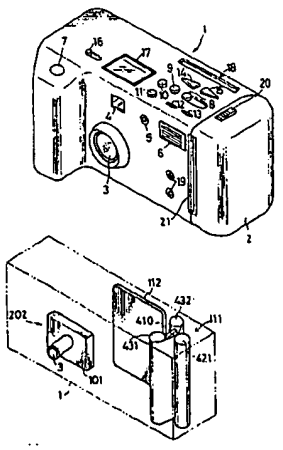
Primary Examiner—Peter S. Wong
Assistant Examiner—Eric Frahm
Attorney, Agent, or Firm—Willian Brinks Hofer Gilson & Lione

[57] **ABSTRACT**

A still video camera includes a photographing device for photographing an object and a printer for printing a photographed image on print paper. The printer has a plurality of printing modes which can be desirably selected. A plurality of sorts of image data for the photographed image are produced. The sort of image data suitable for a selected printing mode is sent to the printer. The print paper is fed under a feeding condition suitable for a selected printing mode. The printing mode is selected in accordance with attachment of an ink ribbon and print paper to the printer.

14 Claims, 34 Drawing Sheets



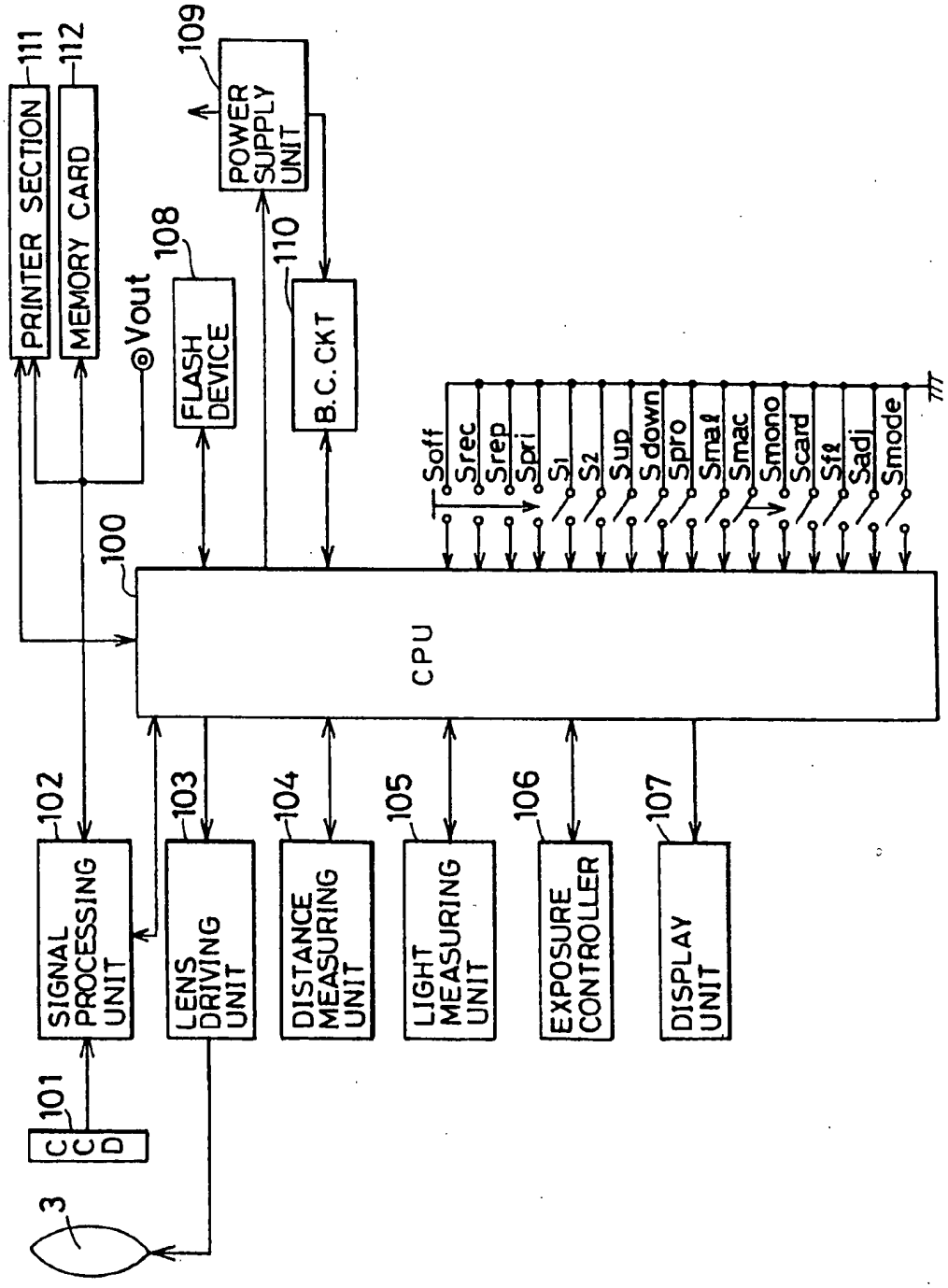
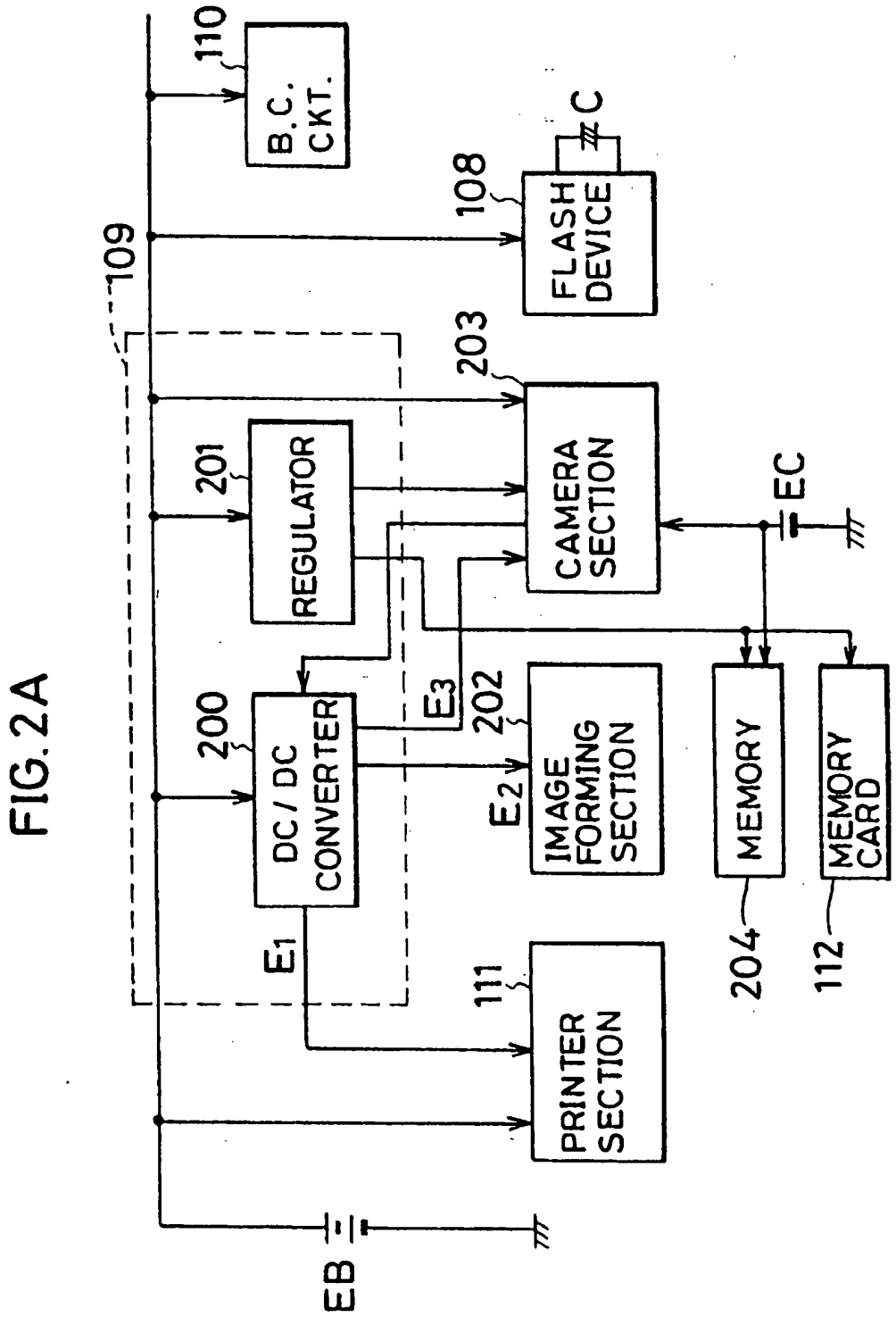

PRINTER SECTION
111
MEMORY CARD
112
Vout
109
POWER SUPPLY UNIT
108
FLASH DEVICE
110
B.C.CKT
Soff
Srec
Srep
Spri
S1
S2
Sup
S.down
Spro
Smal
Smac
Smono
Scard
Sfl
Sadj
Smode
100
CPU
102
SIGNAL PROCESSING UNIT
103
LENS DRIVING UNIT
104
DISTANCE MEASURING UNIT
105
LIGHT MEASURING UNIT
106
EXPOSURE CONTROLLER
107
DISPLAY UNIT
101
C
C
D
3

FIG.1

FIG. 2A


110
B.C. CKT.
C
108
FLASH DEVICE
109
203
CAMERA SECTION
201
REGULATOR
EC
200
DC / DC CONVERTER
E3
202
IMAGE FORMING SECTION
MEMORY
MEMORY CARD
E2
E1
111
PRINTER SECTION
204
112
EB

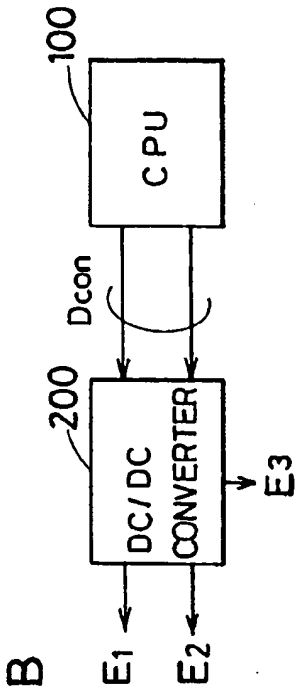

100
CPU
Dcon
200
DC/DC CONVERTER
E3
E1
E2

FIG. 2B

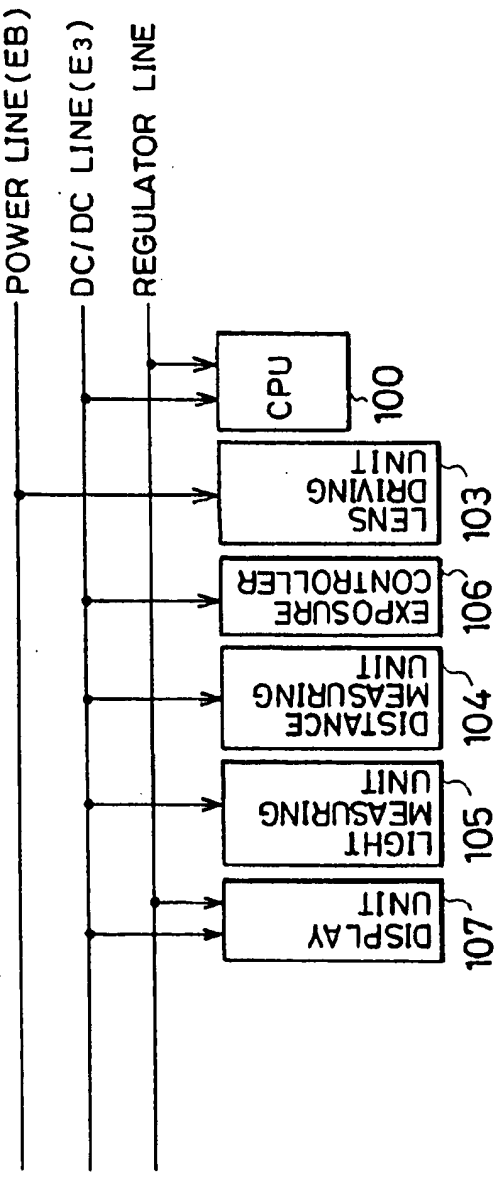

POWER LINE(EB)
DC/DC LINE(E3)
REGULATOR LINE
CPU
100
LENS DRIVING UNIT
103
EXPOSURE CONTROLLER
106
DISTANCE MEASURING UNIT
104
LIGHT MEASURING UNIT
105
DISPLAY UNIT
107

FIG. 2C

FIG. 3A

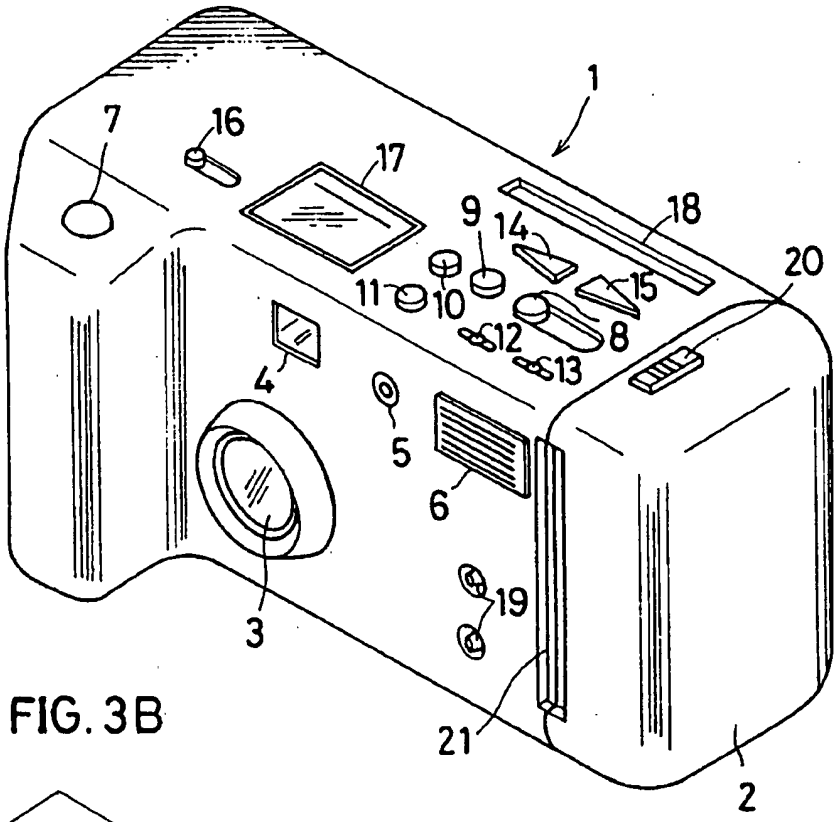

1
7
16
17
18
9
14
20
15
11
10
12
8
13
4
5
6
19
3
21
2

FIG. 3B

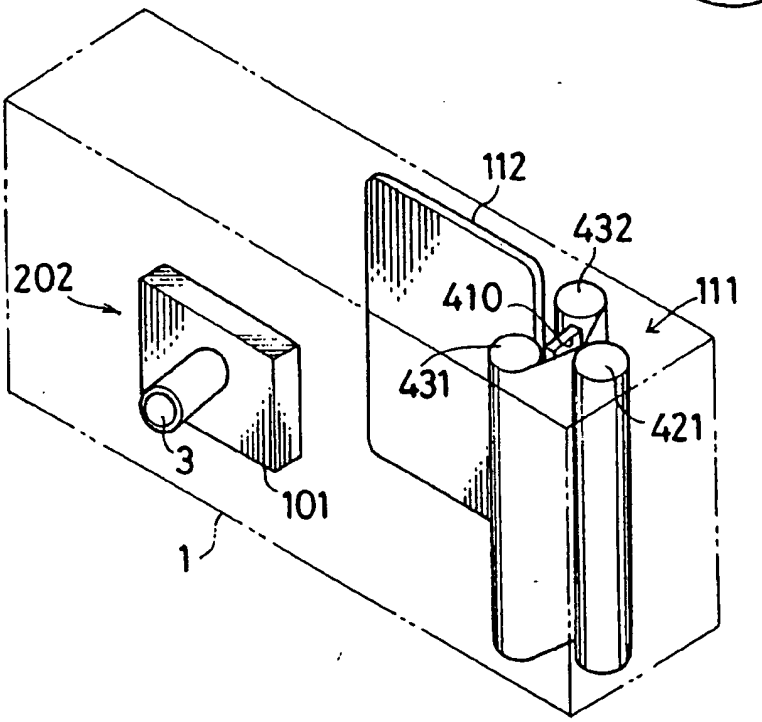
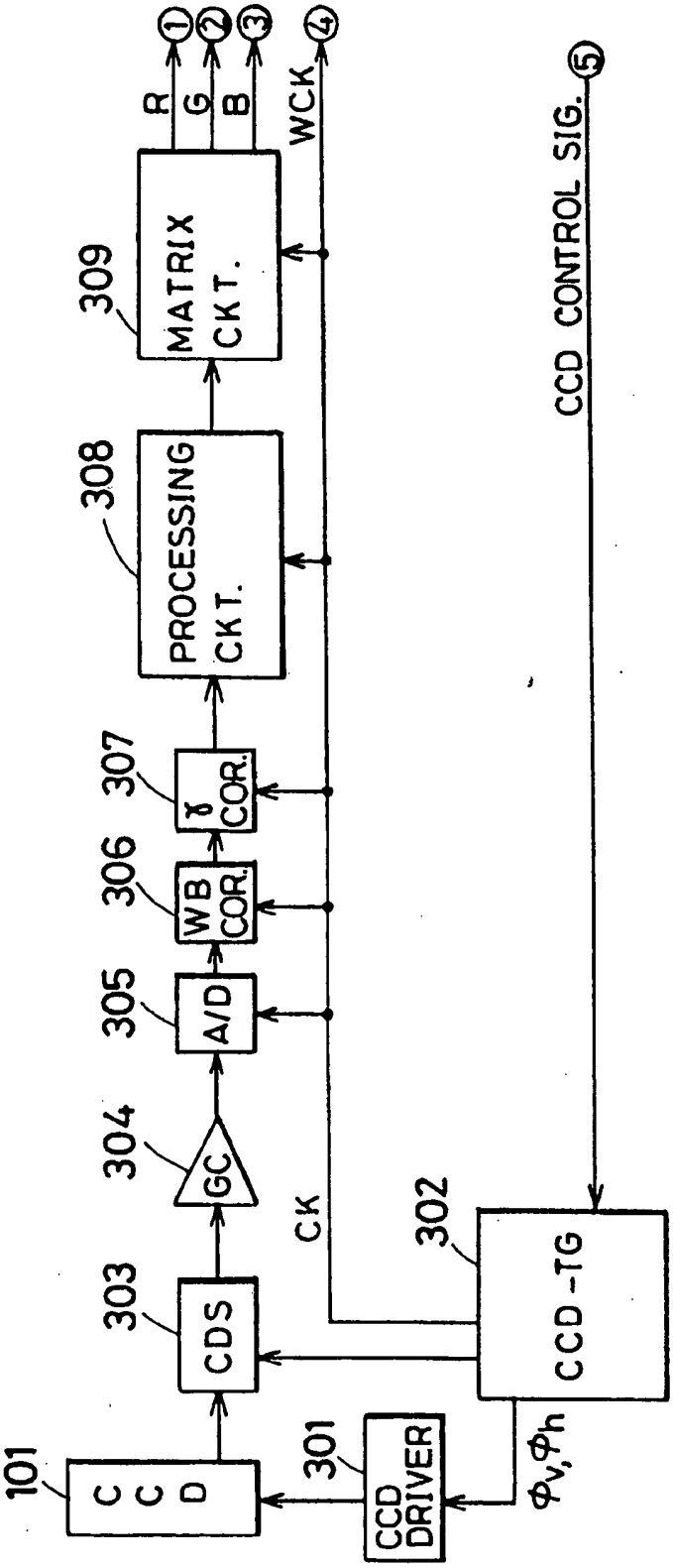

112
432
202
410
111
431
421
3
101
1

FIG. 4A


101
CCD
301
CCD DRIVER
303
CDS
304
GC
305
A/D
306
WB COR.
307
γ COR.
308
PROCESSING CKT.
309
MATRIX CKT.
302
CCD -TG
CK
WCK
R
G
B
CCD CONTROL SIG.
Φv, Φh
1
2
3
4
5

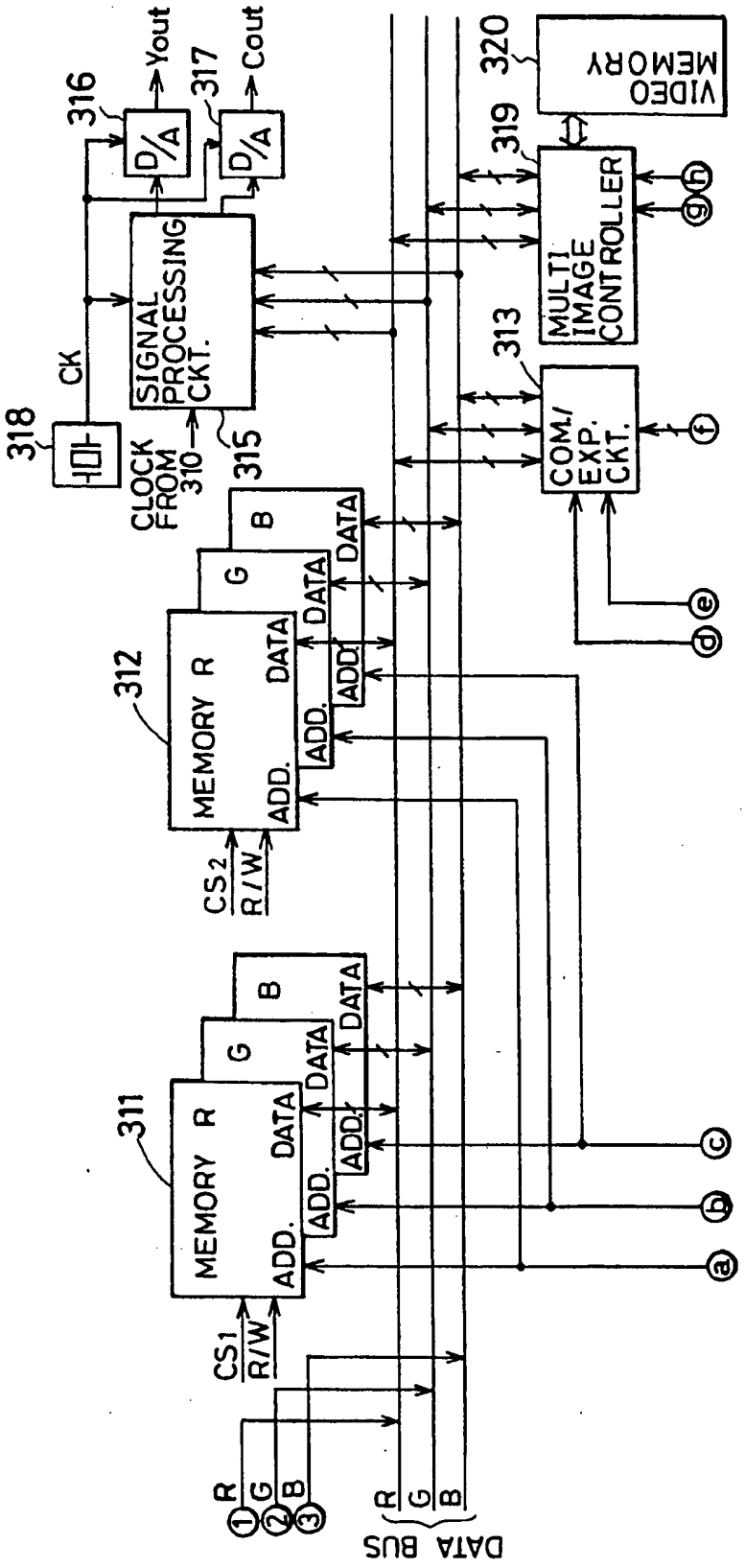

VIDEO MEMORY
320
MULTI IMAGE CONTROLLER
319
COM./ EXP. CKT.
313
SIGNAL PROCESSING CKT.
315
D/A
316
Yout
317
Cout
CK
318
CLOCK FROM 310
MEMORY R
312
MEMORY R
311
G
B
DATA
ADD.
CS2
R/W
CS1
R/W
R
G
B
DATA BUS
a
b
c
d
e
f
g
h
1
2
3

FIG. 4B

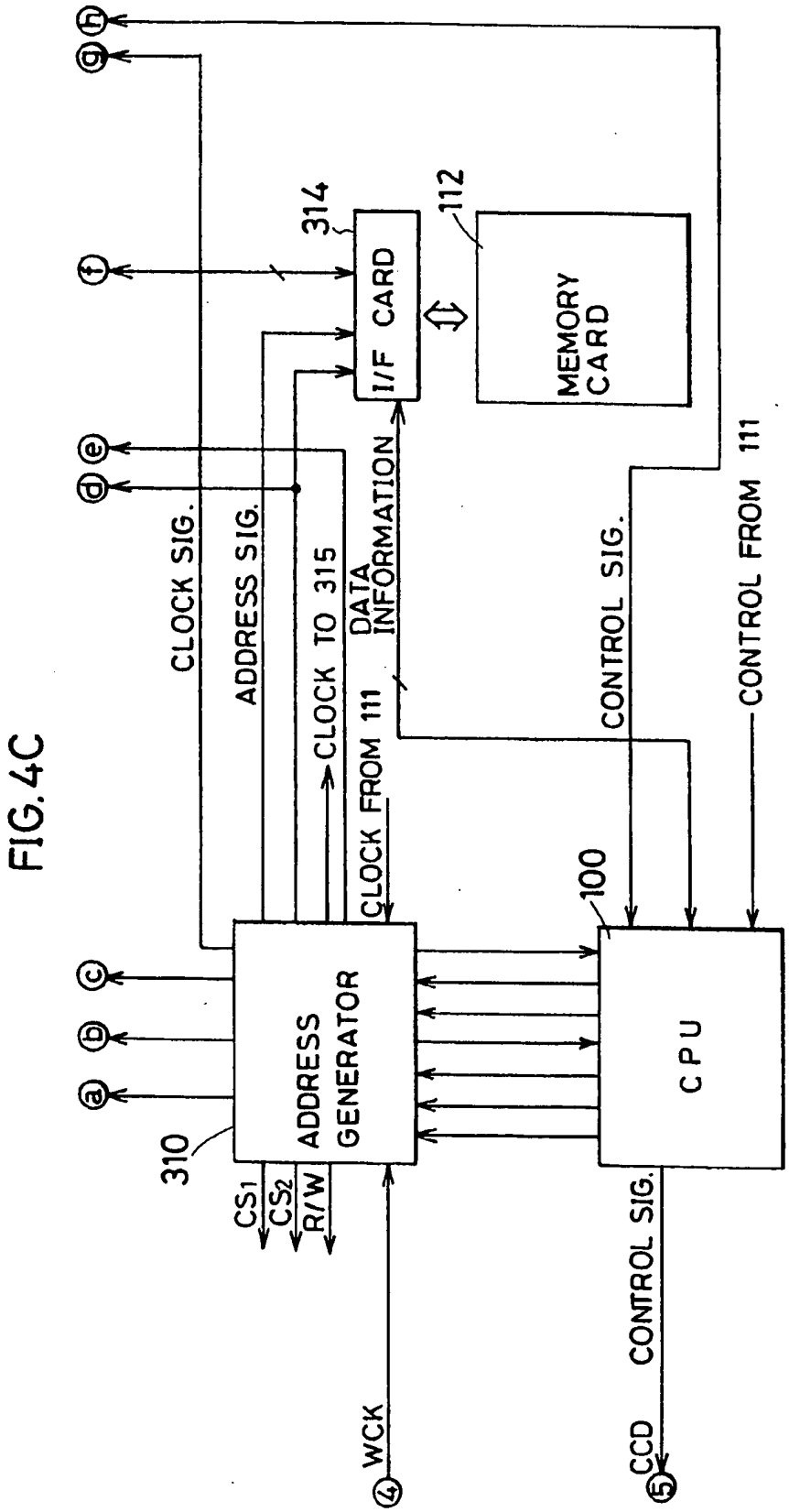

h
g
f
e
d
c
b
a
314
I/F CARD
112
MEMORY CARD
CLOCK SIG.
ADDRESS SIG.
CLOCK TO 315
DATA INFORMATION
CONTROL SIG.
CONTROL FROM 111
CLOCK FROM 111
100
CPU
ADDRESS GENERATOR
310
CS1
CS2
R/W
WCK
4
CONTROL SIG.
CCD
5

FIG. 4C

FIG. 5

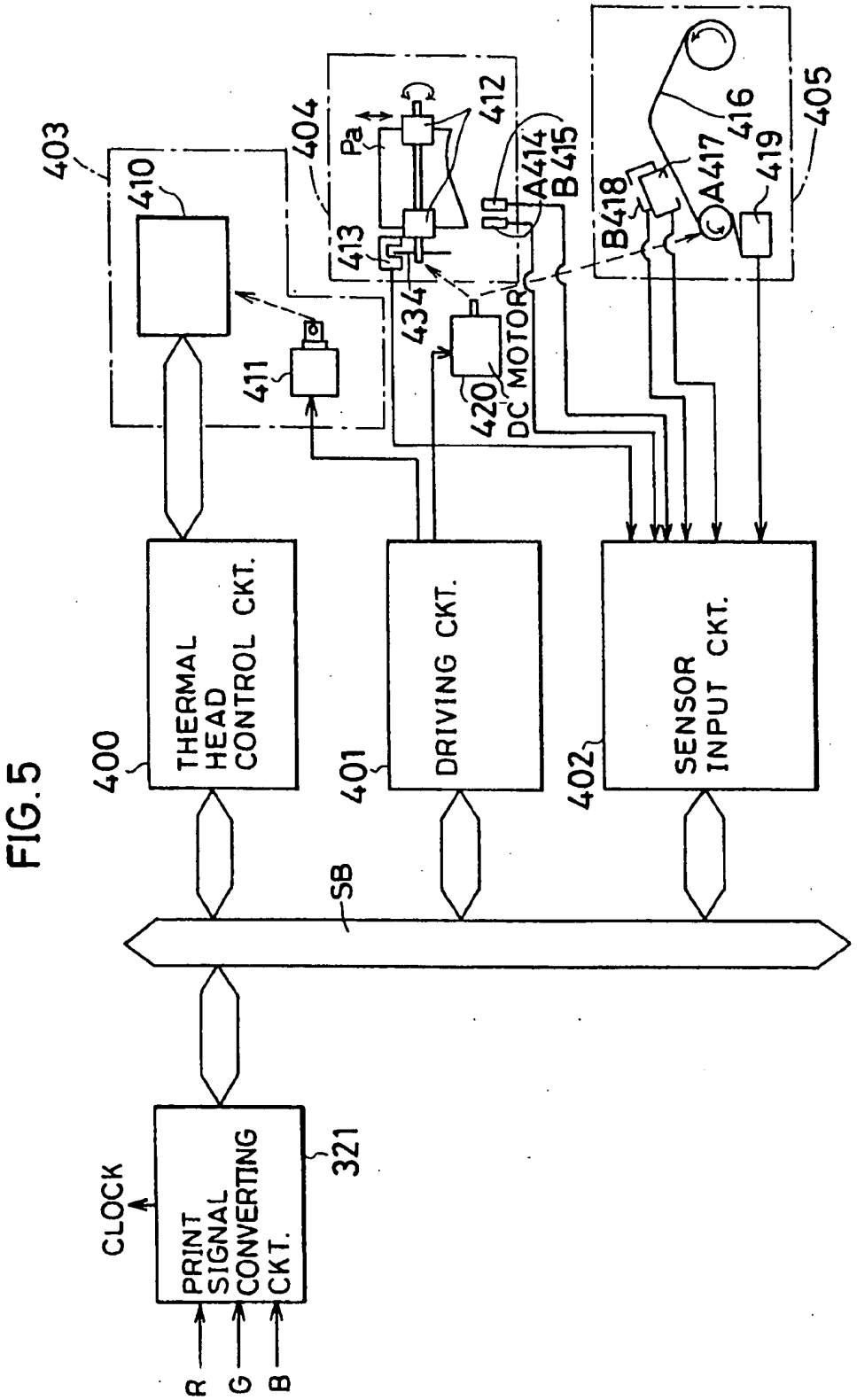

403
410
411
404
Pa
412
413
434
420
DC MOTOR
A414
B415
405
416
A417
419
B418
THERMAL HEAD CONTROL CKT.
400
DRIVING CKT.
401
SENSOR INPUT CKT.
402
SB
CLOCK
PRINT SIGNAL CONVERTING CKT.
321
R
G
B

FIG. 6

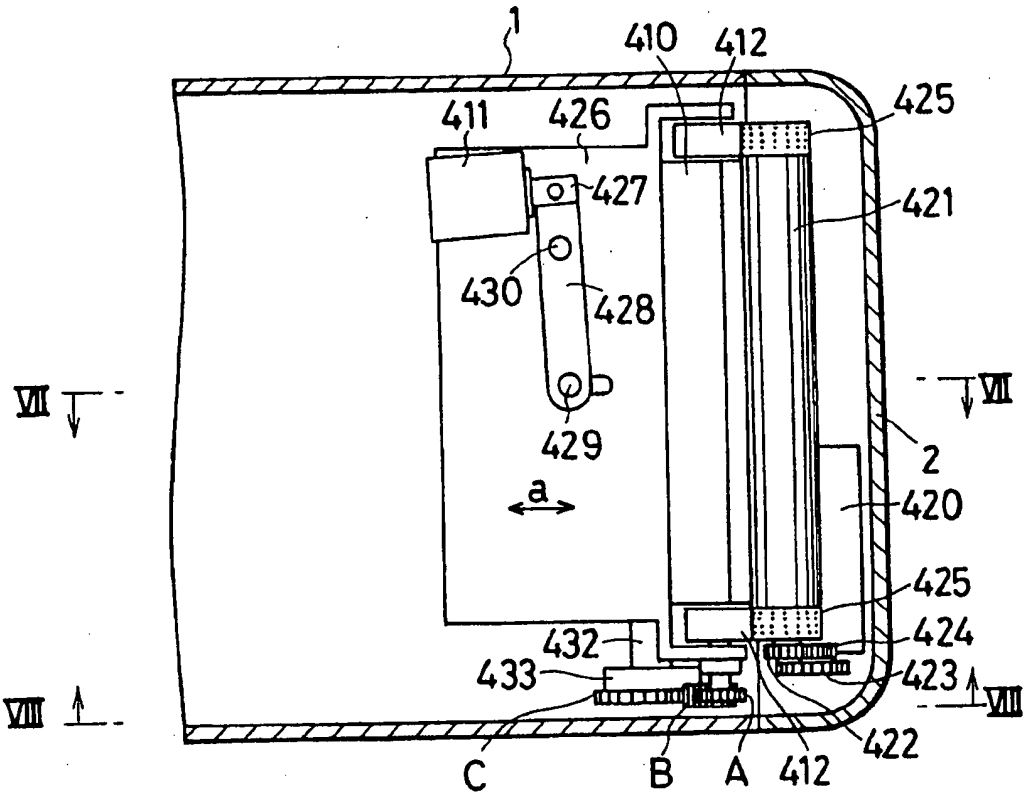

1
410
412
411
426
425
427
421
430
428
VII
VII
429
2
a
420
425
432
424
433
423
VIII
VIII
422
C
B
A
412

FIG. 7

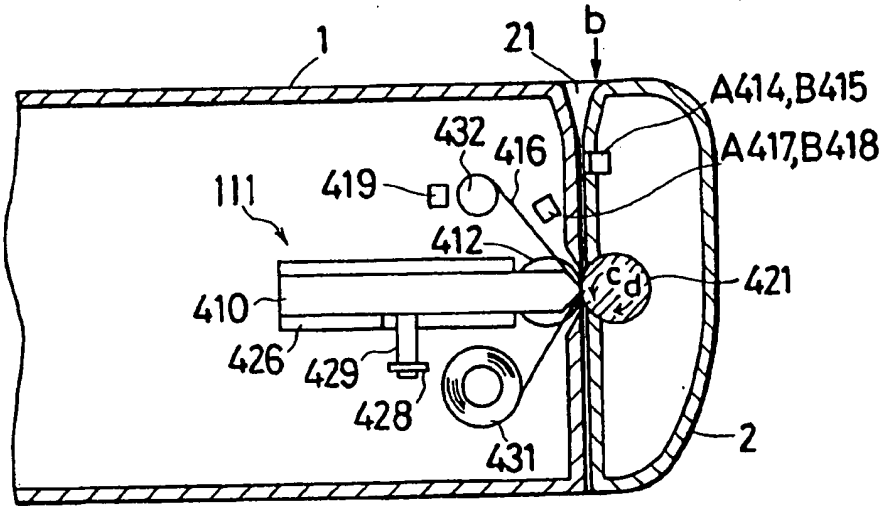
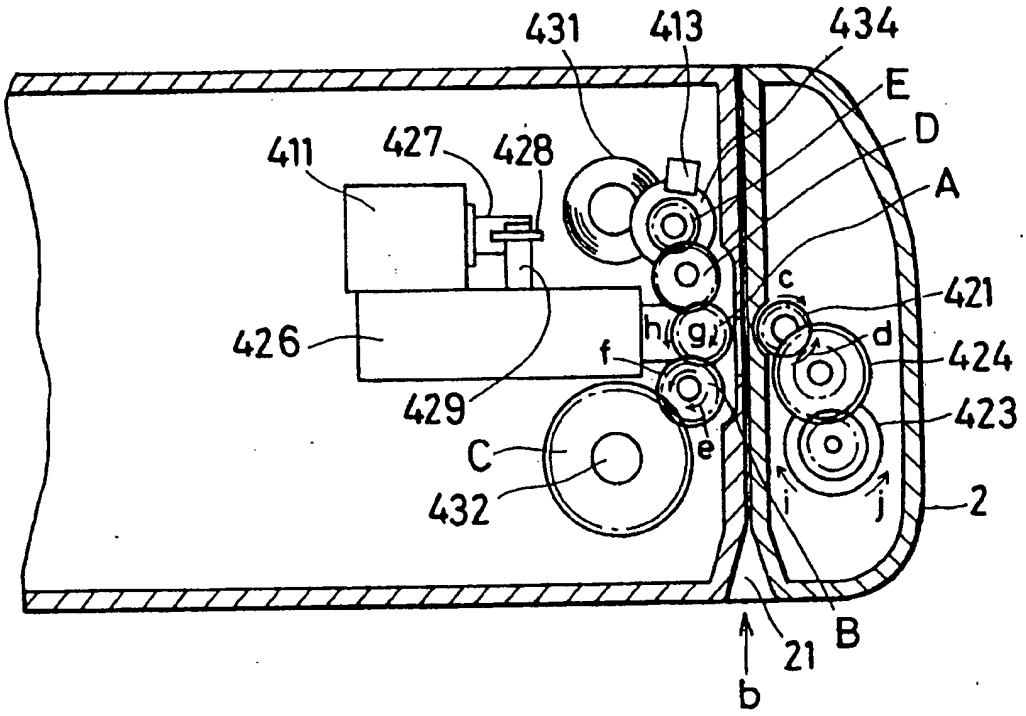

1
21
b
A414,B415
A417,B418
432
416
419
111
412
c
d
421
410
426
429
428
431
2

FIG. 8


431
413
434
E
D
A
411
427
428
421
c
d
424
426
h
g
f
423
429
e
C
432
i
j
2
21
B
b

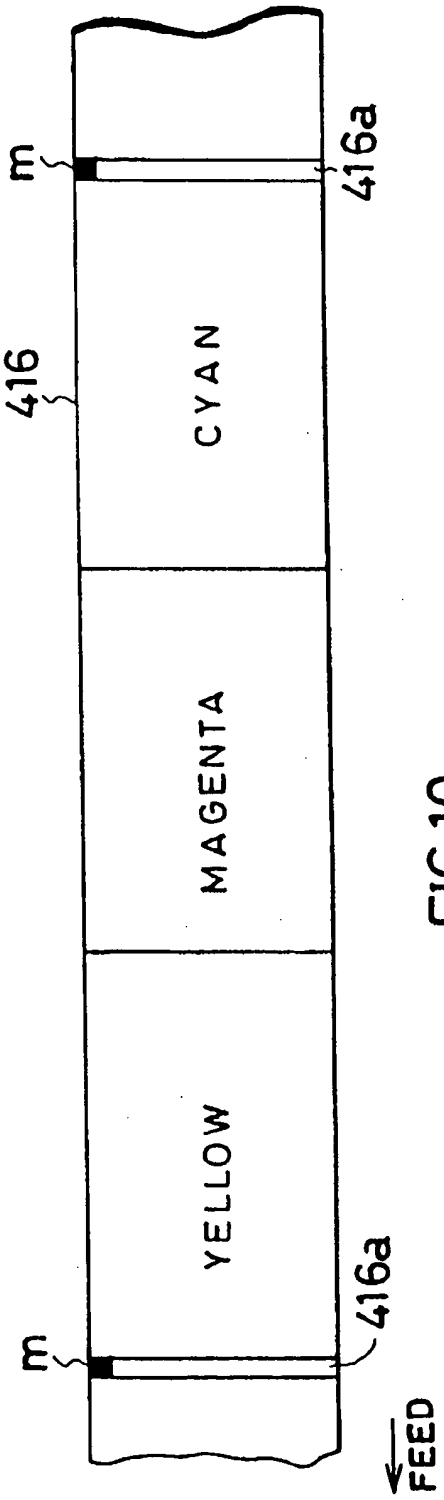

m
416a
416
CYAN
MAGENTA
YELLOW
416a
m
FEED

FIG. 9

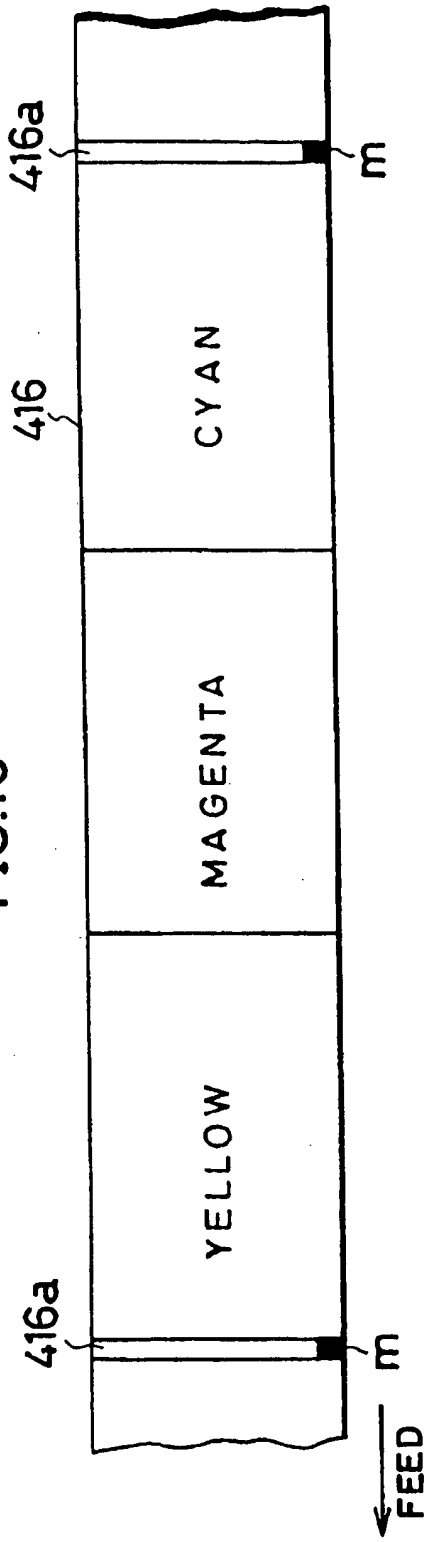

416a
m
416
CYAN
MAGENTA
YELLOW
416a
m
FEED

FIG. 10

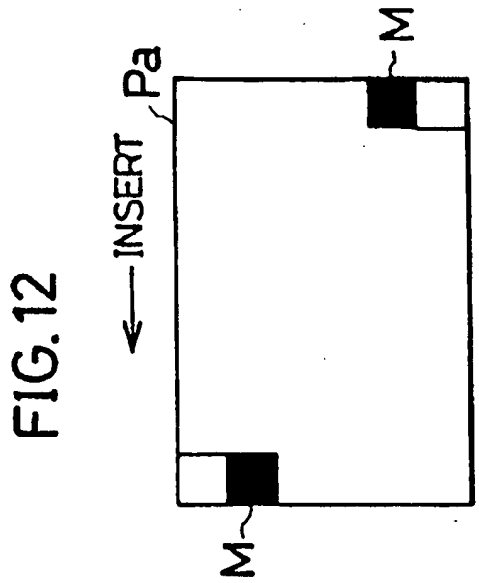


FIG. 12

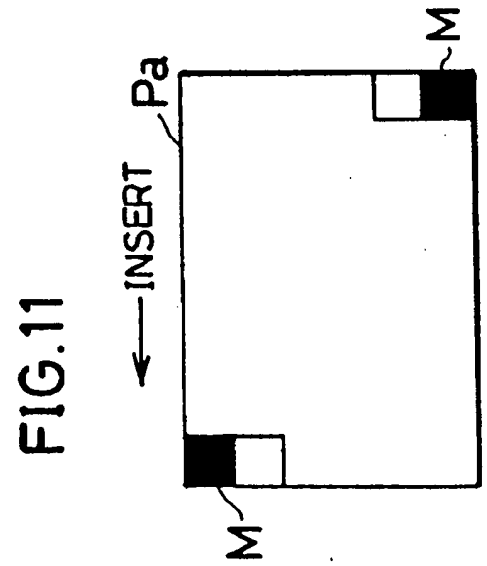


FIG. 11

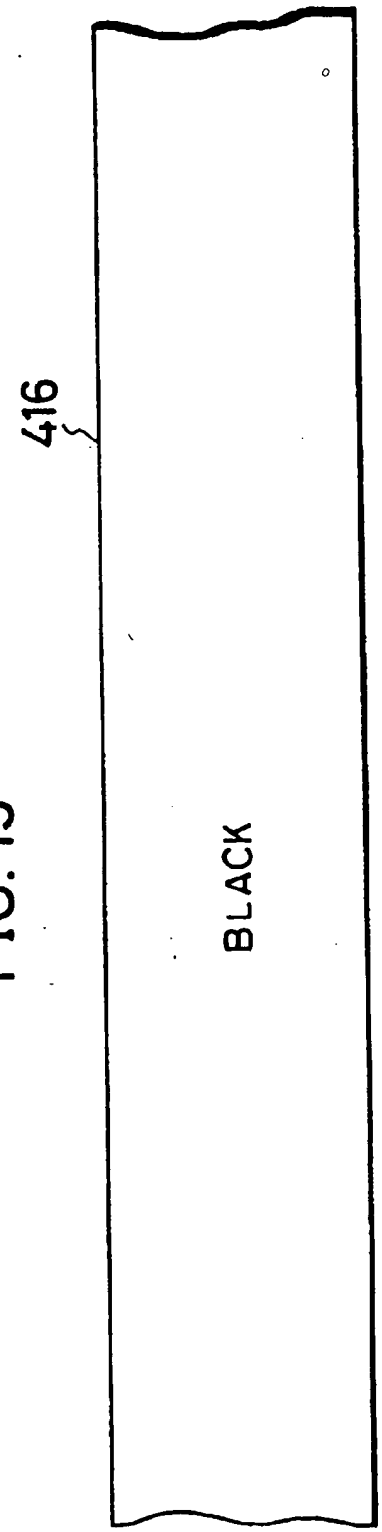


FIG. 13

FIG. 14

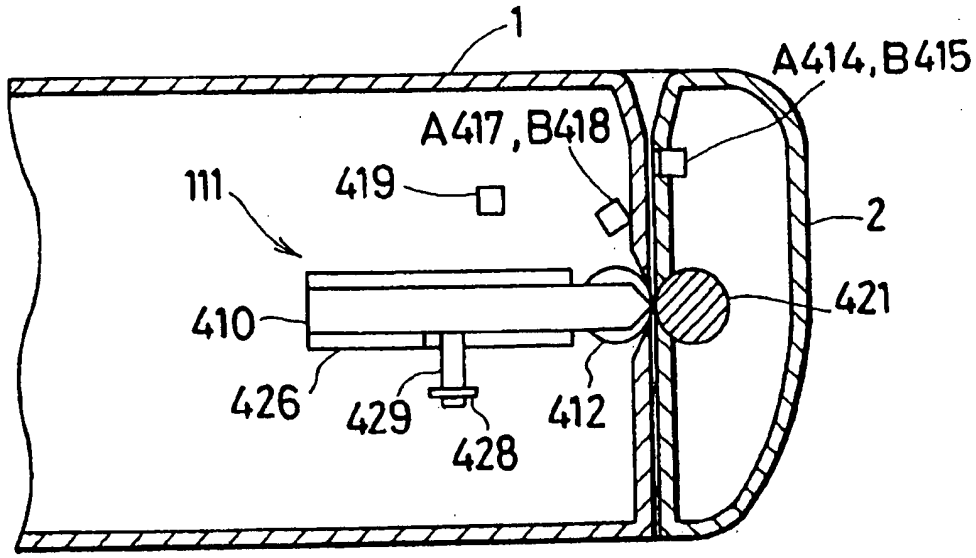

1
A414, B415
A417, B418
111
419
2
421
410
426
429
428
412

FIG. 15

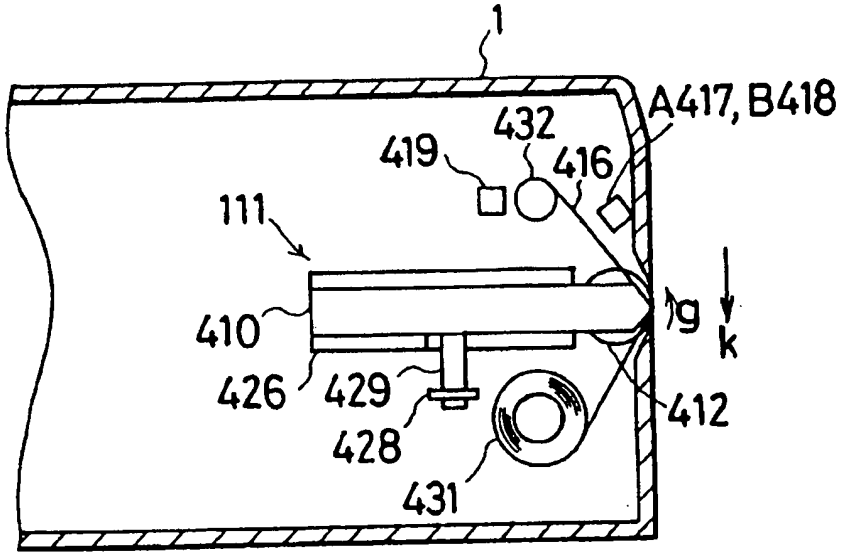

1
A417, B418
432
419
416
111
410
g
k
426
429
428
412
431

FIG.16

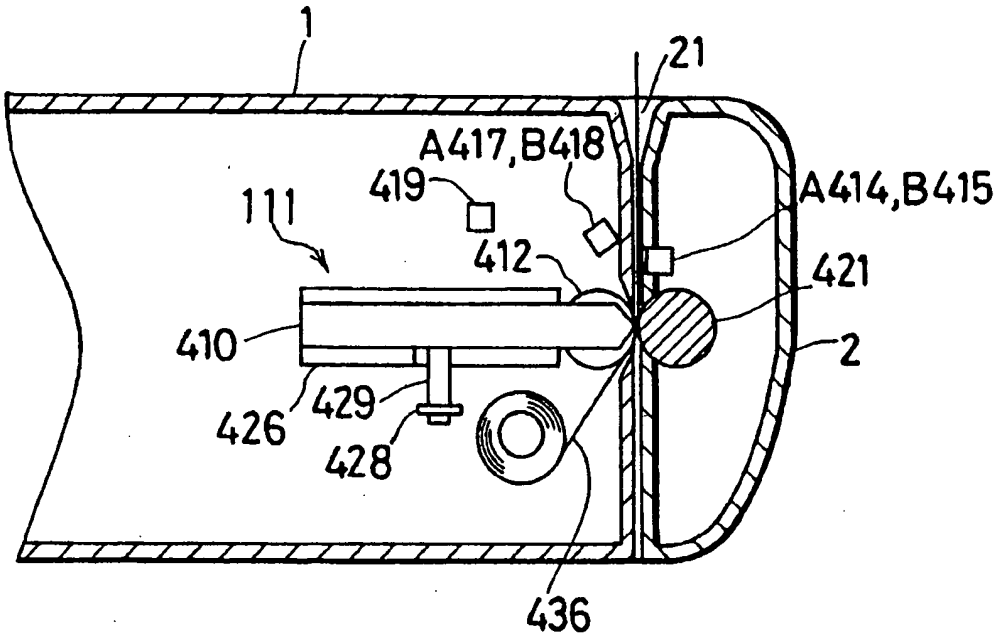
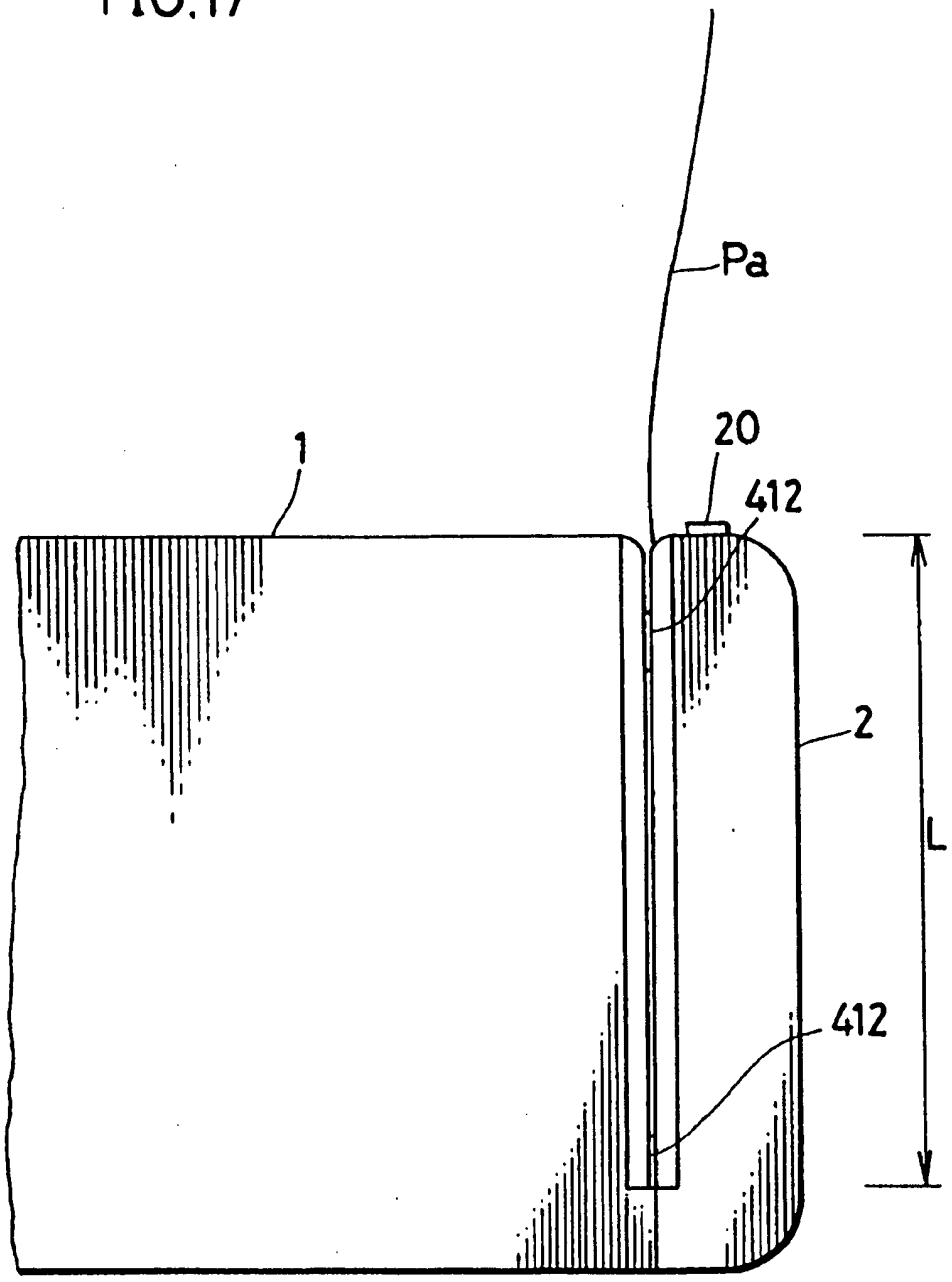


FIG.17



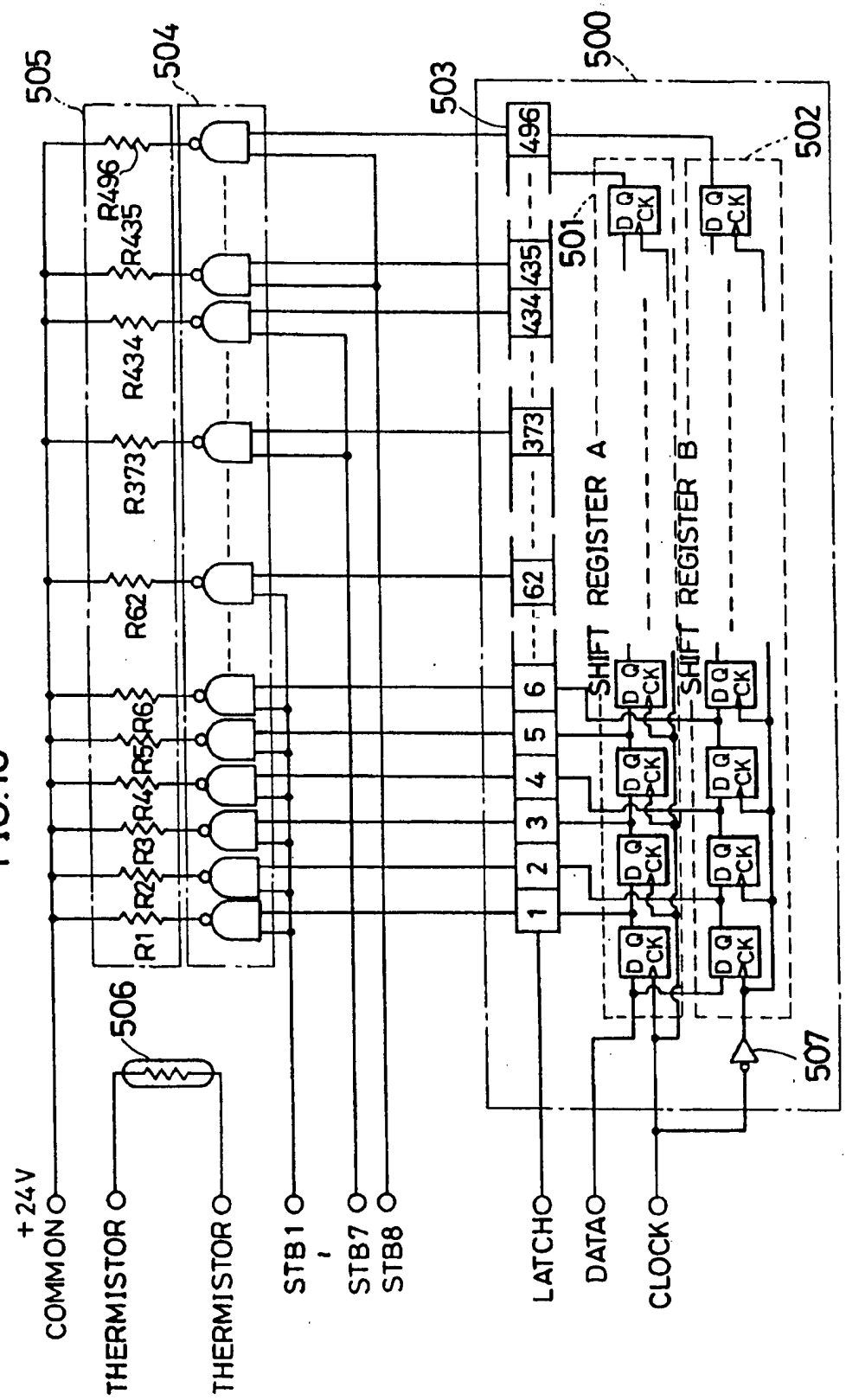

505
504
503
500
502
501
507
506
R496
R435
R434
R373
R62
R6
R5
R4
R3
R2
R1
496
435
434
373
62
6
5
4
3
2
1
SHIFT REGISTER A
SHIFT REGISTER B
D Q
CK
+24V
COMMON
THERMISTOR
THERMISTOR
STB1
STB7
STB8
LATCH
DATA
CLOCK

FIG.18

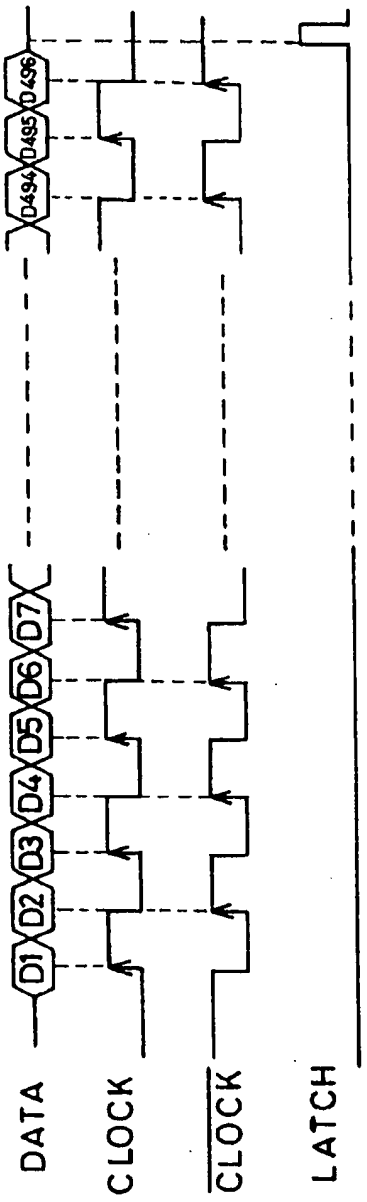

D1
D2
D3
D4
D5
D6
D7
D494
D495
D496
DATA
CLOCK
$\overline{\text{CLOCK}}$
LATCH

FIG.19

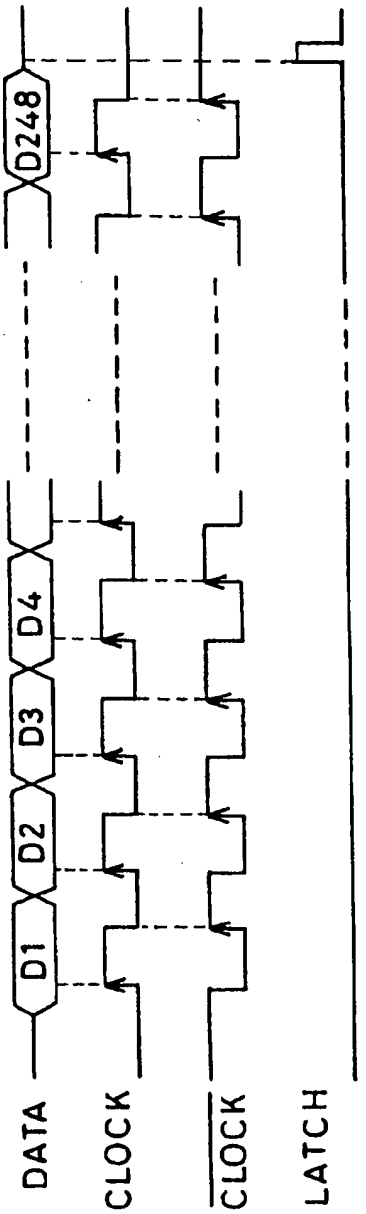

D1
D2
D3
D4
D248
DATA
CLOCK
$\overline{\text{CLOCK}}$
LATCH

FIG.20

FIG. 21

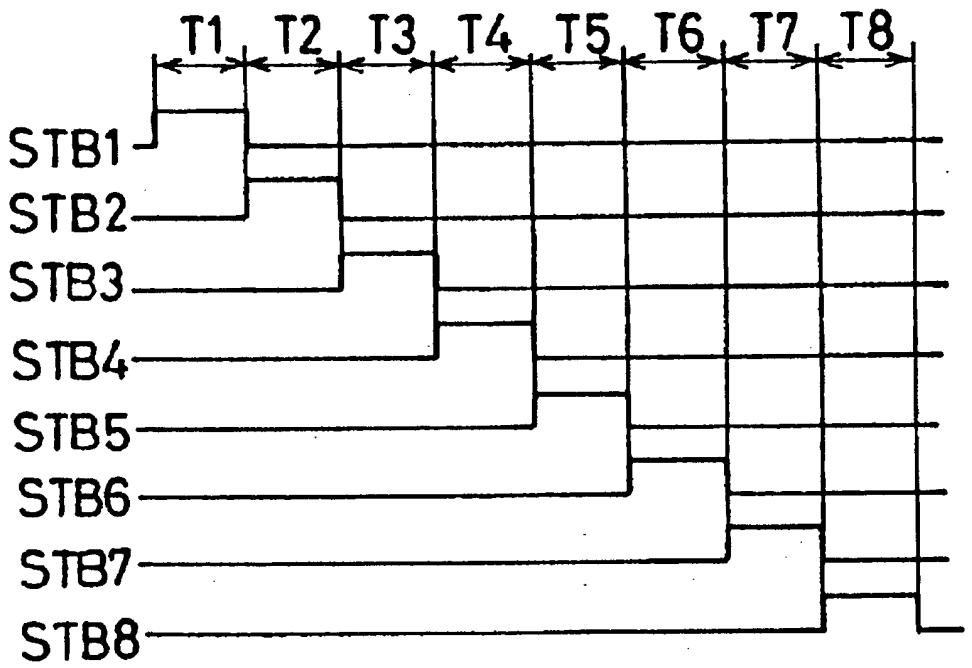


FIG. 22A

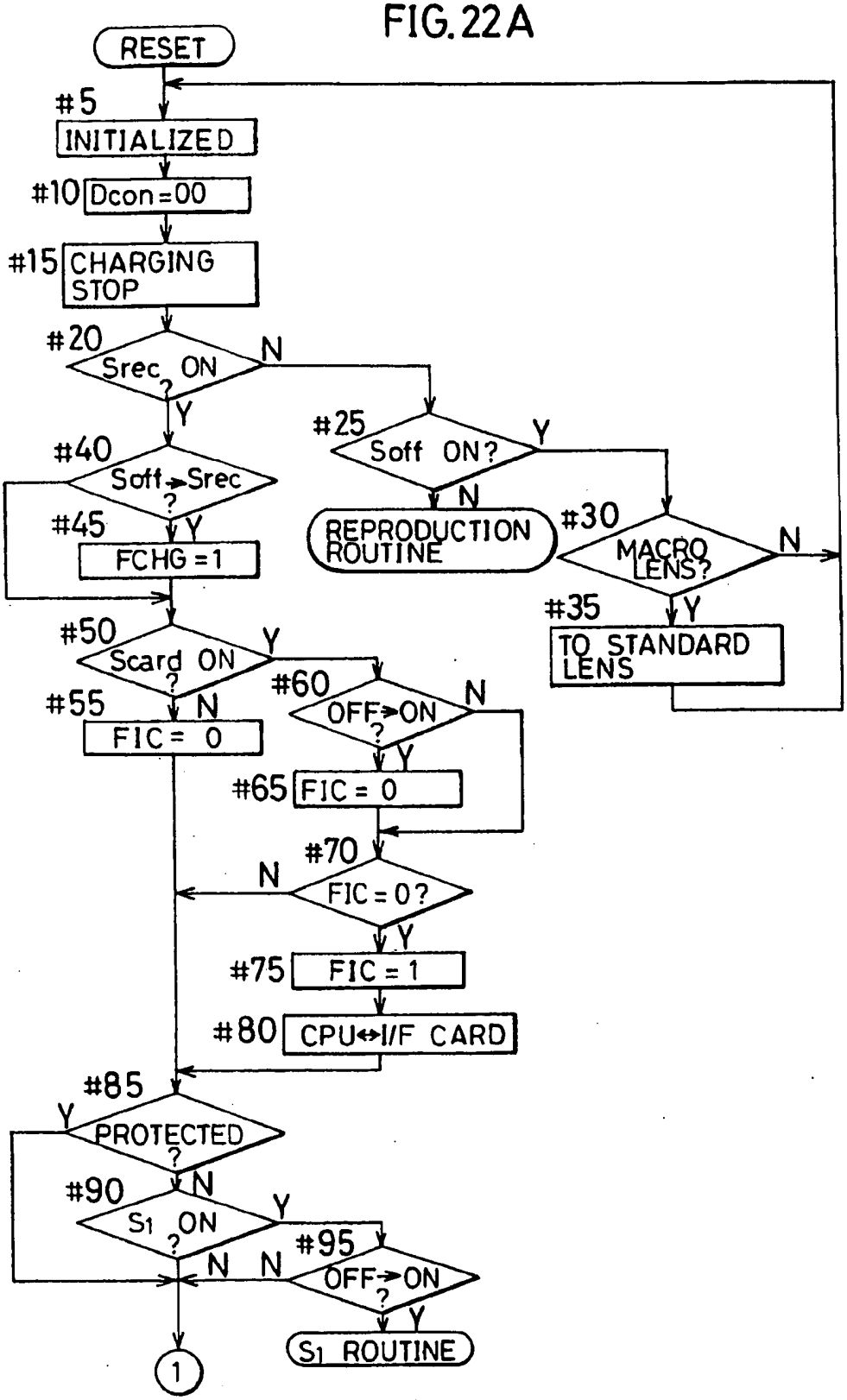

RESET
#5
INITIALIZED
#10
Dcon=00
#15
CHARGING STOP
#20
Srec ON?
N
Y
#25
Soff ON?
Y
N
REPRODUCTION ROUTINE
#30
MACRO LENS?
N
Y
#35
TO STANDARD LENS
#40
Soff→Srec?
Y
#45
FCHG=1
#50
Scard ON?
Y
#55
FIC=0
N
#60
OFF→ON?
N
Y
#65
FIC=0
#70
FIC=0?
N
Y
#75
FIC=1
#80
CPU↔I/F CARD
#85
PROTECTED?
Y
N
#90
S1 ON?
Y
N
#95
OFF→ON?
N
Y
S1 ROUTINE
1

FIG. 22B

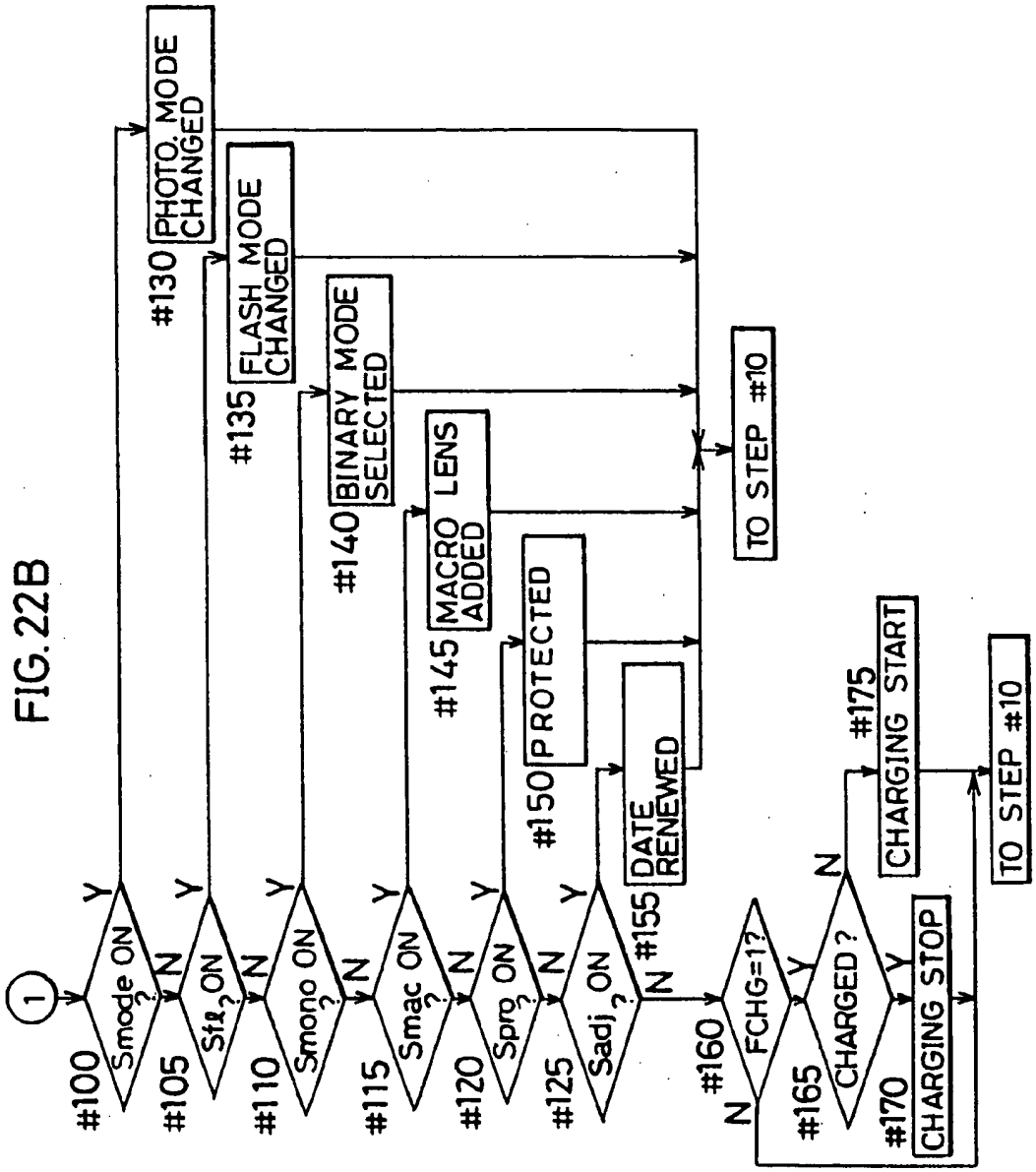
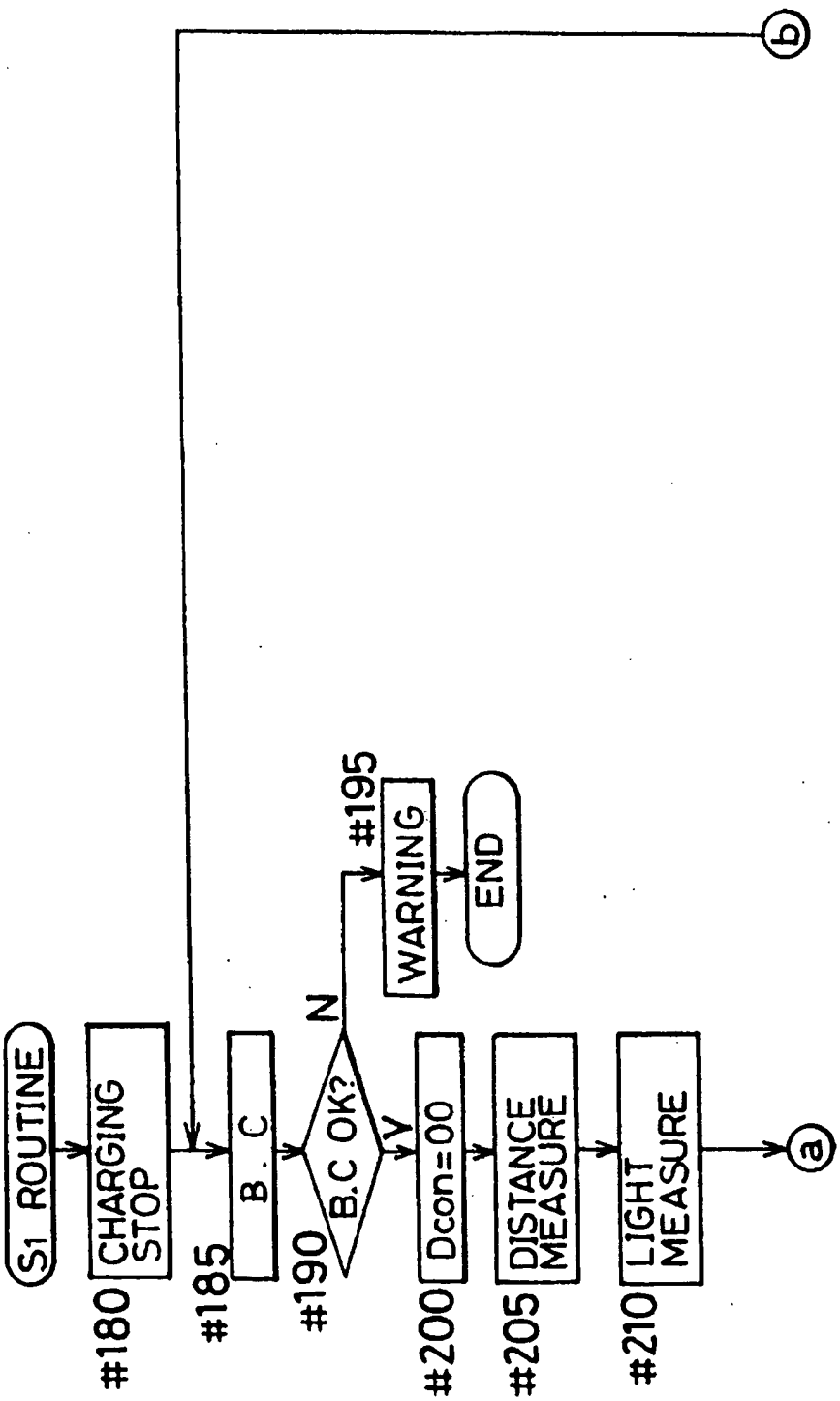

1
#100
Smode ON ?
Y
N
#105
St$_2$ ON
#110
Smono ON ?
#115
Smac ON ?
#120
Spro ON ?
#125
Sadj$_2$ ON
#130
PHOTO. MODE CHANGED
#135
FLASH MODE CHANGED
#140
BINARY MODE SELECTED
#145
MACRO LENS ADDED
#150
PROTECTED
#155
DATE RENEWED
#160
FCHG=1?
#165
CHARGED ?
#170
CHARGING STOP
#175
CHARGING START
TO STEP #10
TO STEP #10

FIG. 23A


S1 ROUTINE
CHARGING STOP
#180
B.C
#185
B.C OK?
#190
N
Y
#195
WARNING
END
Dcon=00
#200
DISTANCE MEASURE
#205
LIGHT MEASURE
#210
b
a

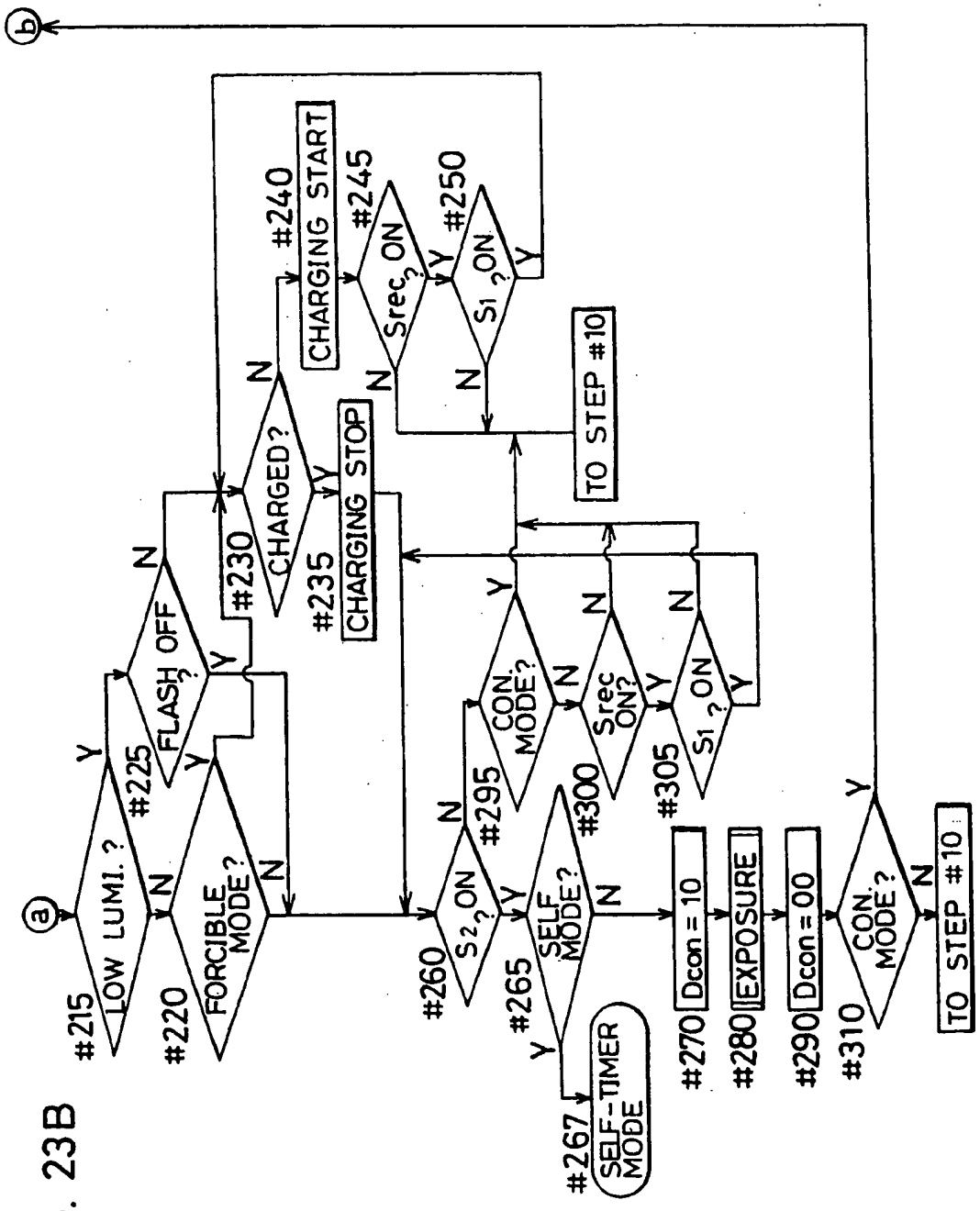

b
#240
CHARGING START
#245
Srec2 ON
#250
S1 2ON
N
Y
TO STEP #10
#230
CHARGED?
#235
CHARGING STOP
FLASH OFF?
#225
a
#215
LOW LUMI.?
#220
FORCIBLE MODE?
#260
S2 ON?
#265
SELF MODE?
#267
SELF-TIMER MODE
#295
CON. MODE?
#300
Srec ON?
#305
S1 2ON
#270
Dcon = 10
#280
EXPOSURE
#290
Dcon = 00
#310
CON. MODE?
TO STEP #10

FIG. 23B

FIG. 24

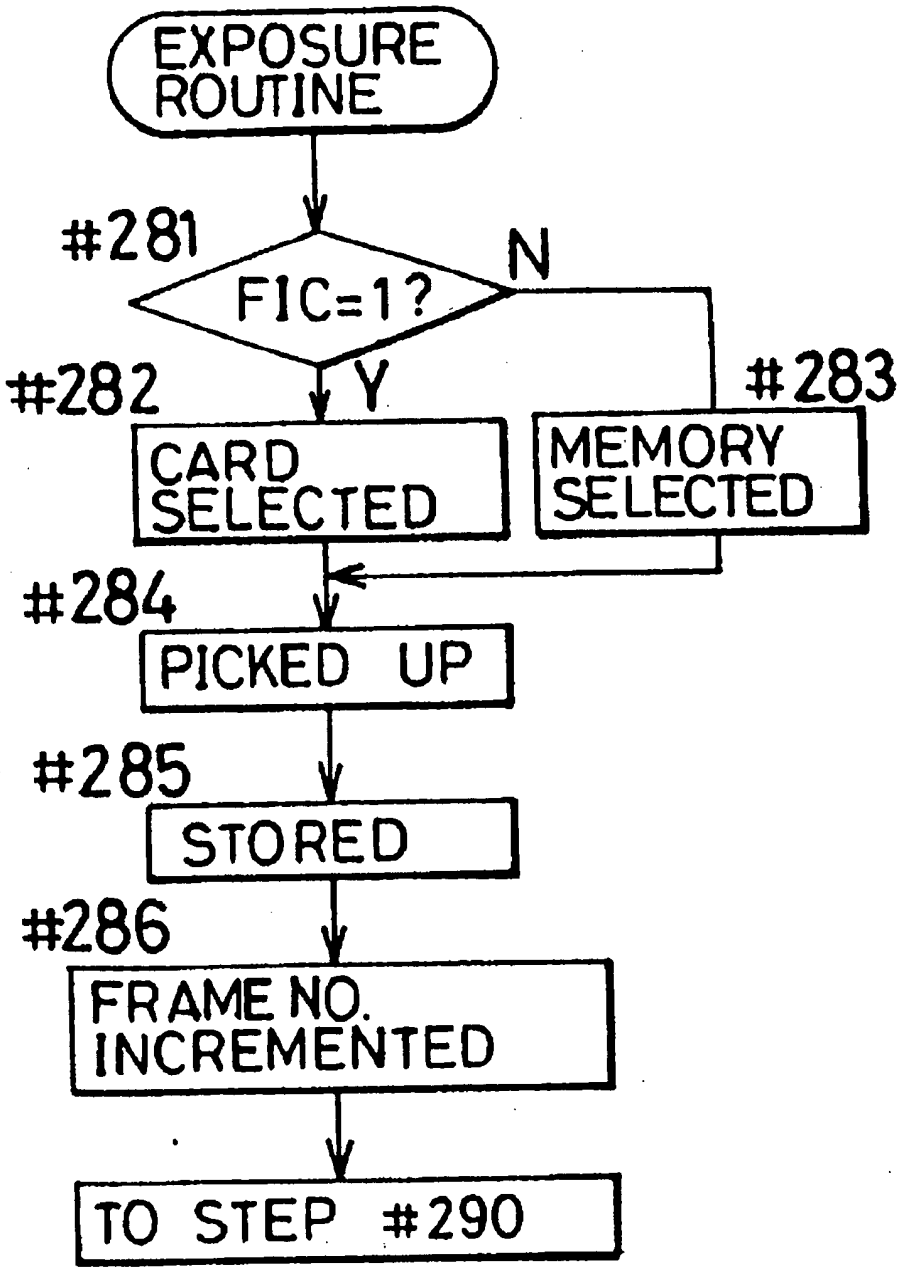

EXPOSURE ROUTINE
#281
FIC=1?
N
Y
#282
CARD SELECTED
#283
MEMORY SELECTED
#284
PICKED UP
#285
STORED
#286
FRAME NO. INCREMENTED
TO STEP #290

FIG. 25A

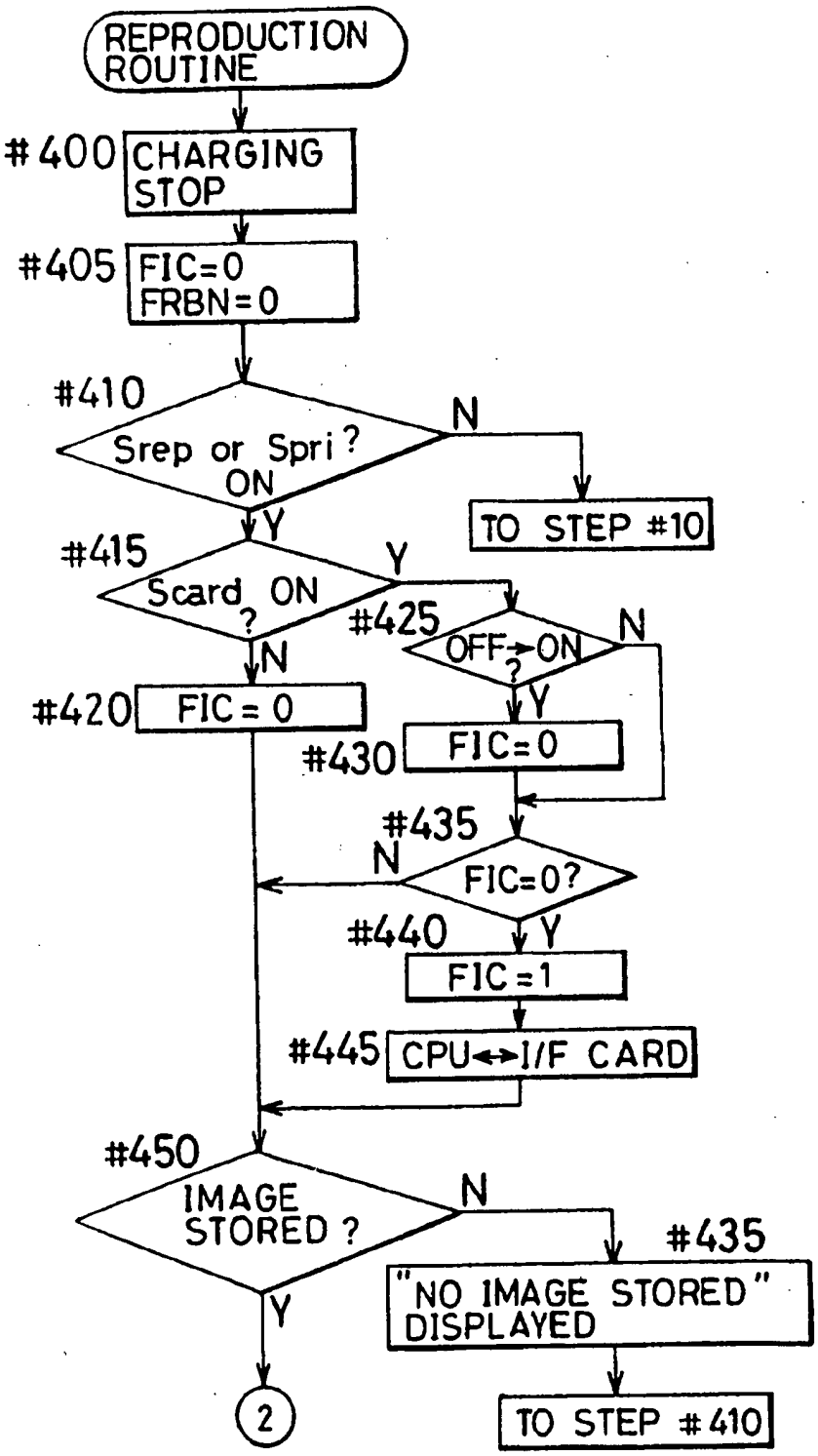

REPRODUCTION ROUTINE
#400
CHARGING STOP
#405
FIC=0
FRBN=0
#410
Srep or Spri ON ?
N
TO STEP #10
Y
#415
Scard ON ?
Y
#425
OFF→ON ?
N
Y
N
#420
FIC = 0
#430
FIC=0
#435
N
FIC=0?
Y
#440
FIC=1
#445
CPU↔I/F CARD
#450
IMAGE STORED ?
N
#435
"NO IMAGE STORED" DISPLAYED
Y
TO STEP #410
2

FIG. 25B

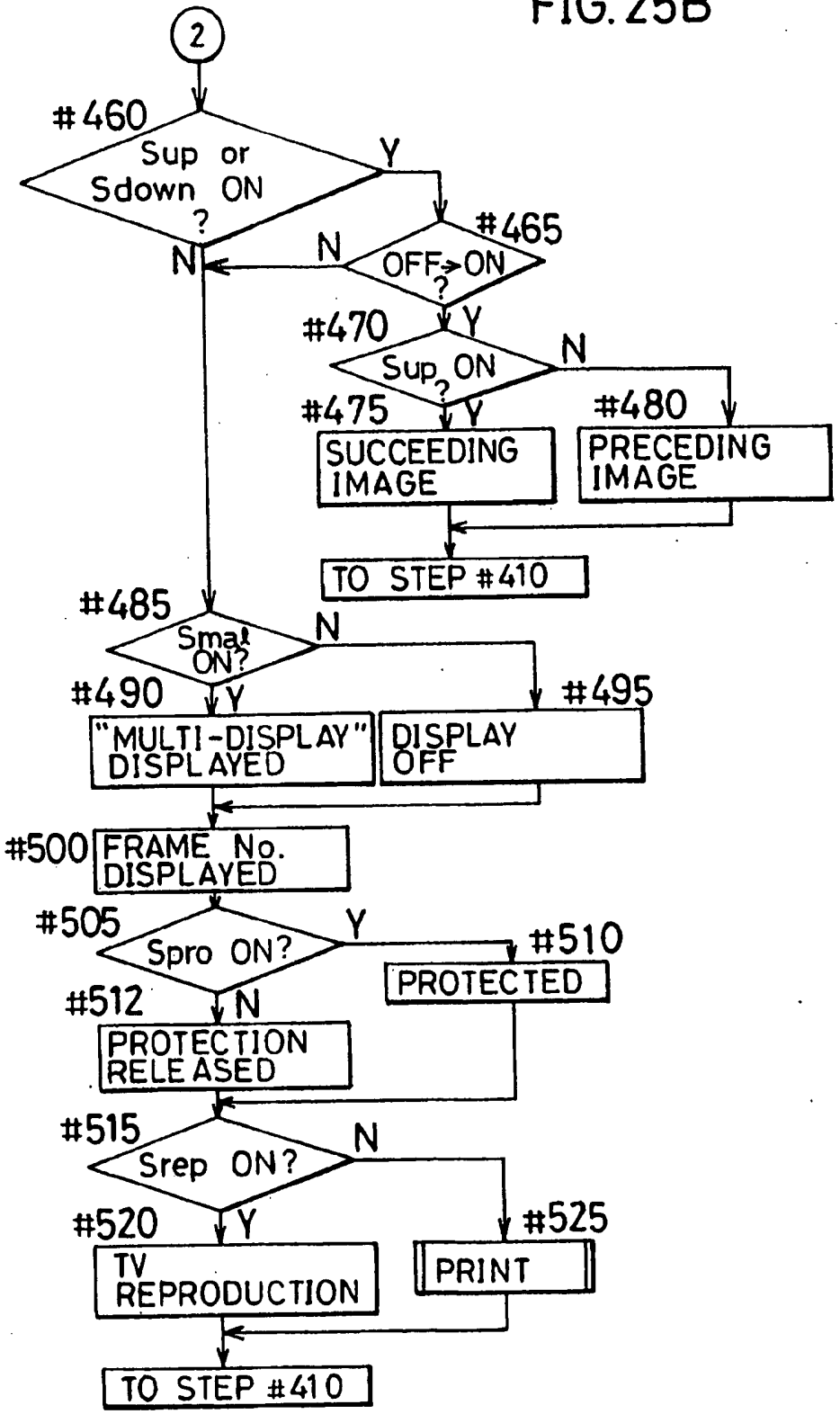
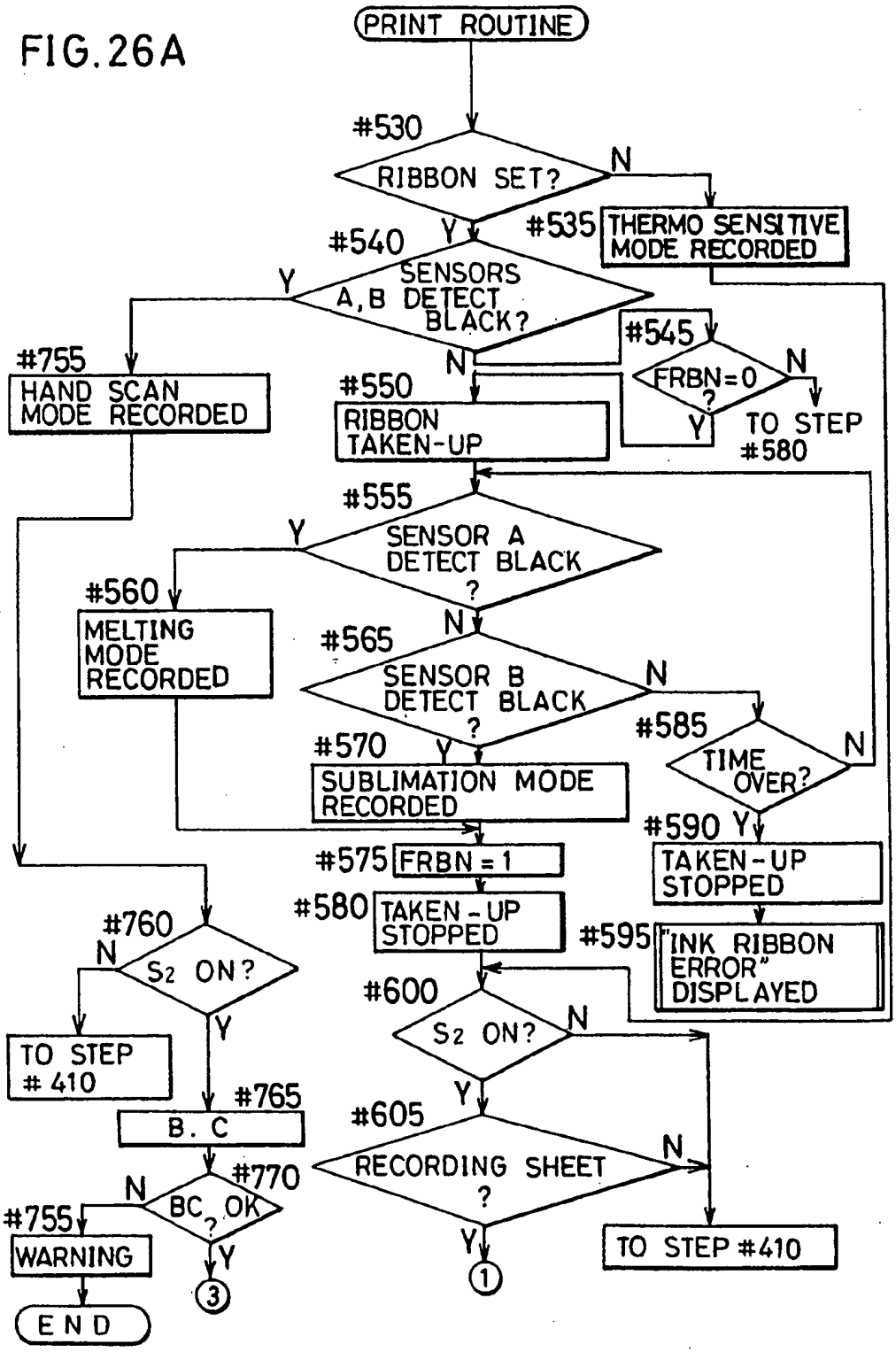

2
#460
Sup or Sdown ON ?
Y
N
#465
OFF→ON ?
N
Y
#470
Sup ON ?
N
Y
#475
SUCCEEDING IMAGE
#480
PRECEDING IMAGE
TO STEP #410
#485
Smal ON?
N
Y
#490
"MULTI-DISPLAY" DISPLAYED
#495
DISPLAY OFF
#500
FRAME No. DISPLAYED
#505
Spro ON?
Y
#510
PROTECTED
#512
N
PROTECTION RELEASED
#515
Srep ON?
N
Y
#520
TV REPRODUCTION
#525
PRINT
TO STEP #410

FIG. 26A


PRINT ROUTINE
#530
RIBBON SET?
N
#535
THERMO SENSITIVE MODE RECORDED
Y
#540
SENSORS A, B DETECT BLACK?
Y
#755
HAND SCAN MODE RECORDED
N
#545
FRBN=0 ?
N
Y
TO STEP #580
#550
RIBBON TAKEN-UP
#555
SENSOR A DETECT BLACK ?
Y
#560
MELTING MODE RECORDED
N
#565
SENSOR B DETECT BLACK ?
N
#585
TIME OVER?
N
#570
SUBLIMATION MODE RECORDED
Y
#590
TAKEN-UP STOPPED
#575
FRBN = 1
#580
TAKEN-UP STOPPED
#595
"INK RIBBON ERROR" DISPLAYED
#760
S2 ON?
N
#600
S2 ON?
N
TO STEP # 410
Y
#765
B. C
Y
#605
RECORDING SHEET ?
N
#770
BC, OK ?
N
#755
WARNING
Y
TO STEP #410
Y
3
1
END

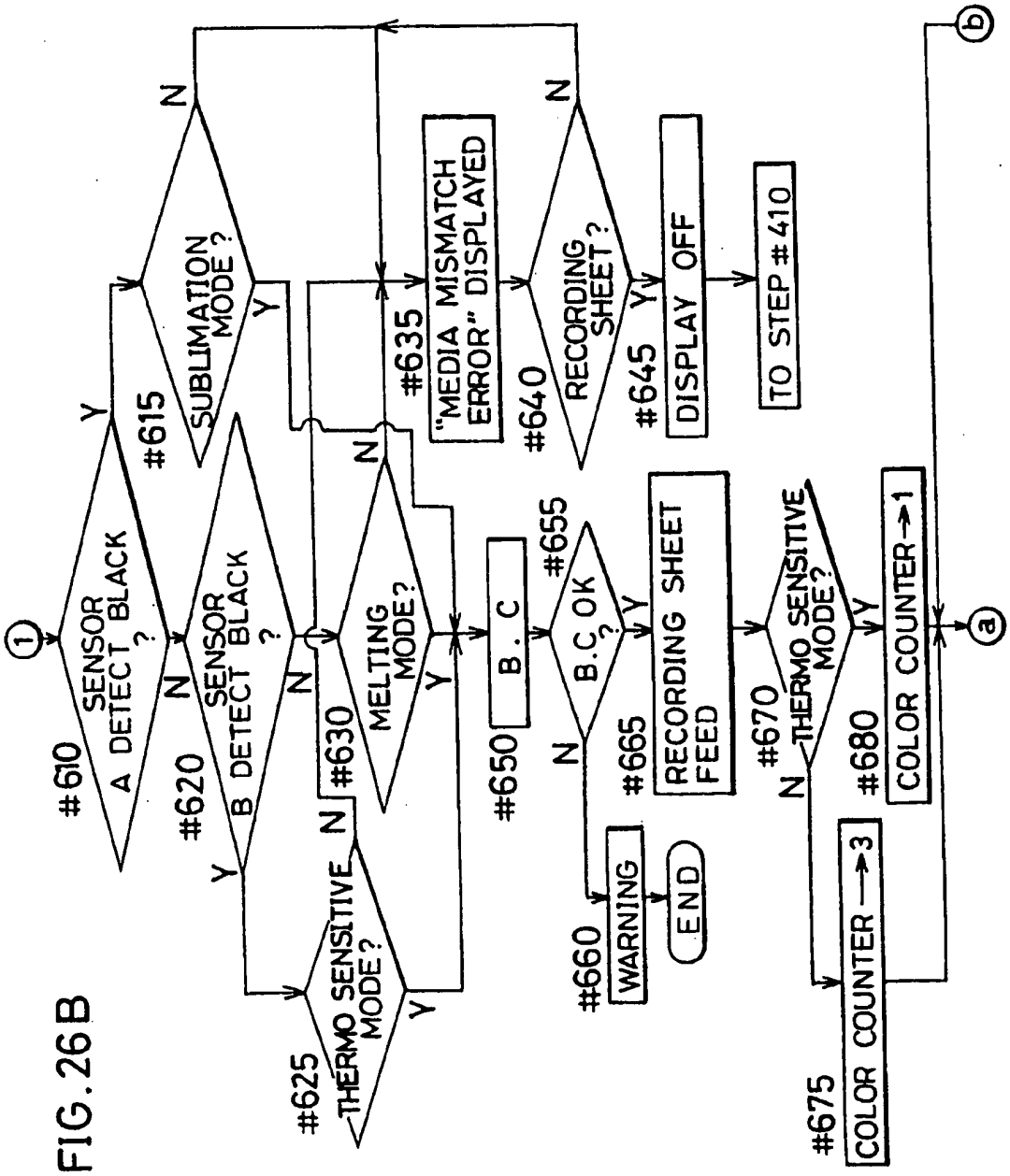

①
#610
SENSOR A DETECT BLACK ?
Y
N
#615
SUBLIMATION MODE?
Y
N
#620
SENSOR B DETECT BLACK ?
Y
N
#625
THERMO SENSITIVE MODE?
Y
N
#630
MELTING MODE?
Y
N
#635
"MEDIA MISMATCH ERROR" DISPLAYED
#640
RECORDING SHEET?
Y
N
#645
DISPLAY OFF
TO STEP #410
#650
B.C
#655
B.C OK?
Y
N
#660
WARNING
END
#665
RECORDING SHEET FEED
#670
THERMO SENSITIVE MODE?
Y
N
#675
COLOR COUNTER →3
#680
COLOR COUNTER →1
ⓐ
ⓑ

FIG. 26B

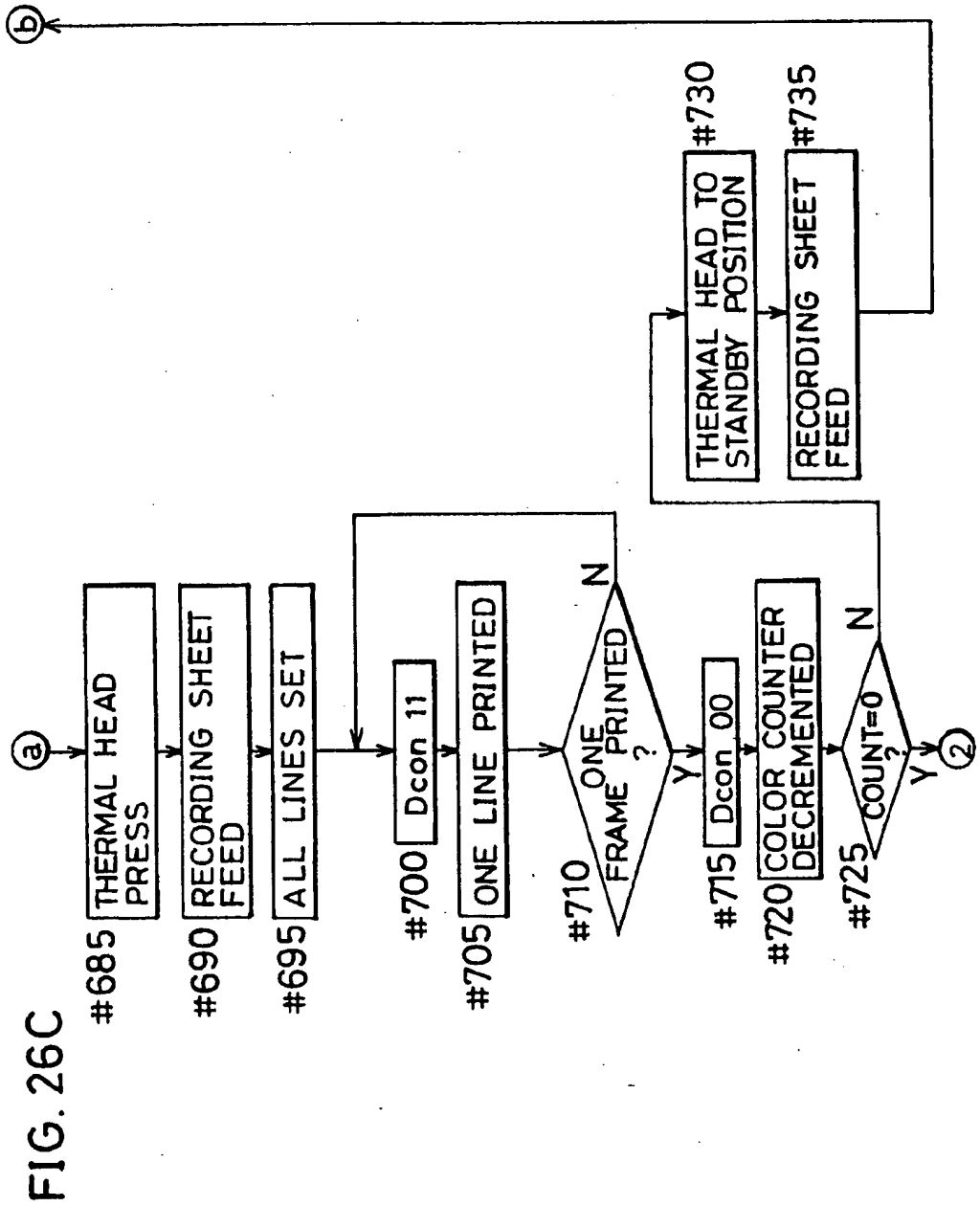

a
THERMAL HEAD PRESS
#685
RECORDING SHEET FEED
#690
ALL LINES SET
#695
Dcon 11
#700
ONE LINE PRINTED
#705
ONE FRAME PRINTED ?
#710
N
Y
Dcon 00
#715
COLOR COUNTER DECREMENTED
#720
COUNT=0 ?
#725
N
Y
2
THERMAL HEAD TO STANDBY POSITION
#730
RECORDING SHEET FEED
#735
b

FIG. 26C

FIG. 26D

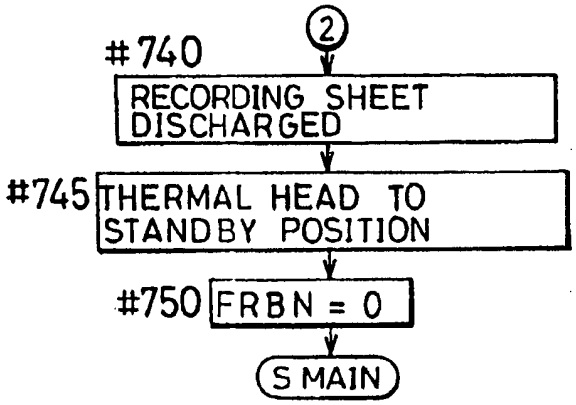


FIG. 26E

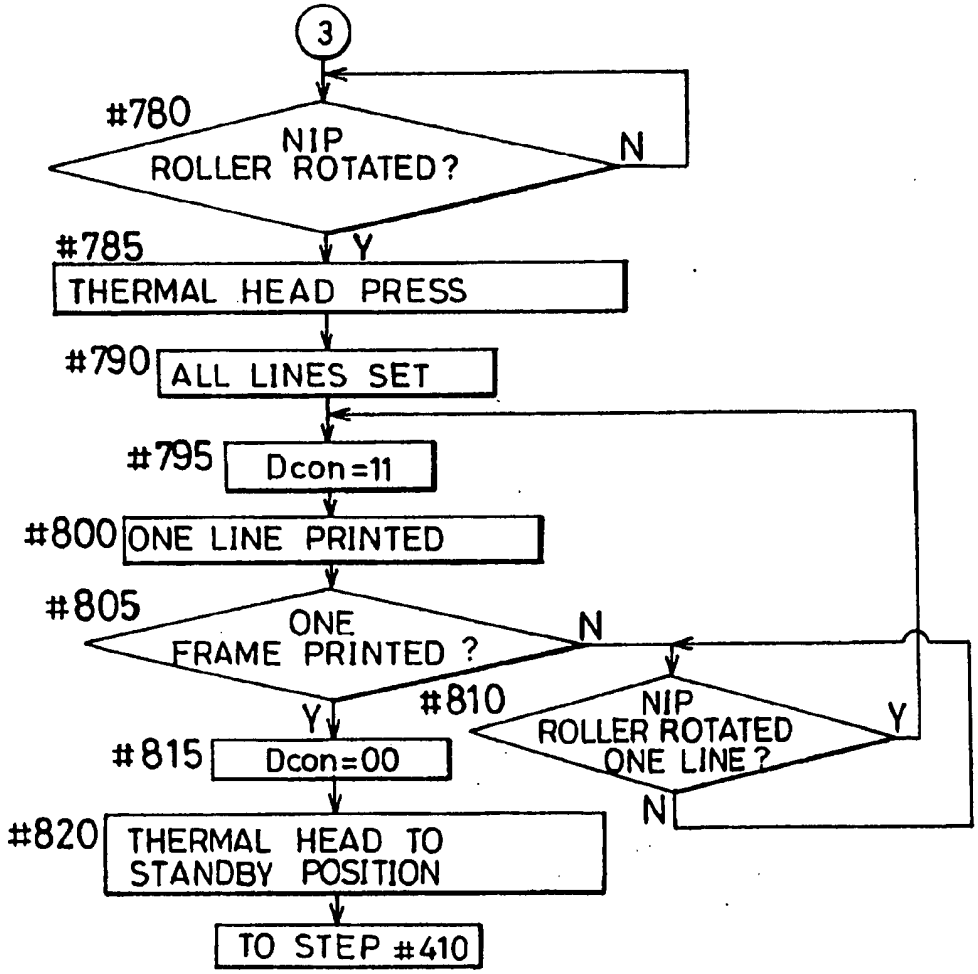


FIG. 27

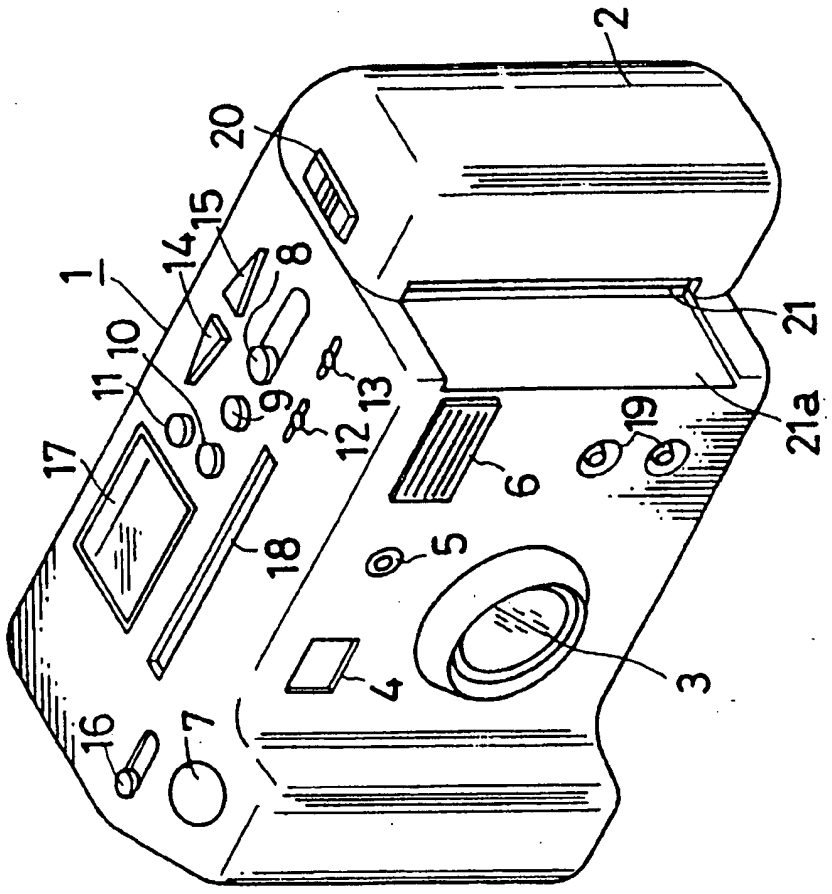


FIG. 28

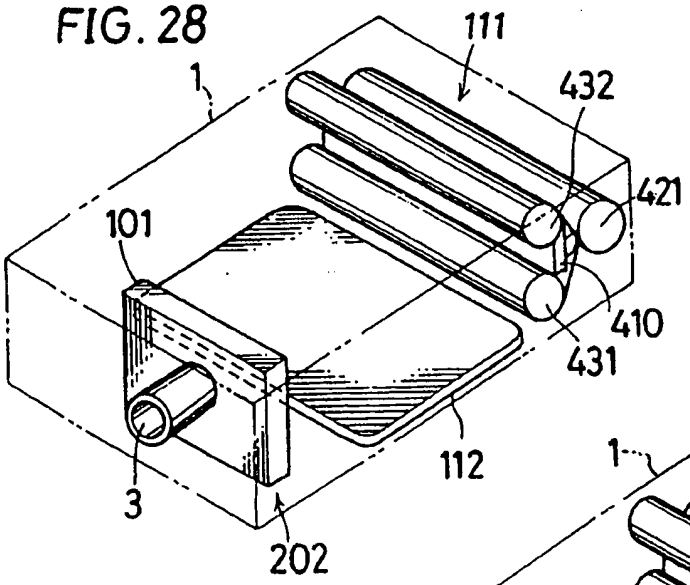


FIG. 29

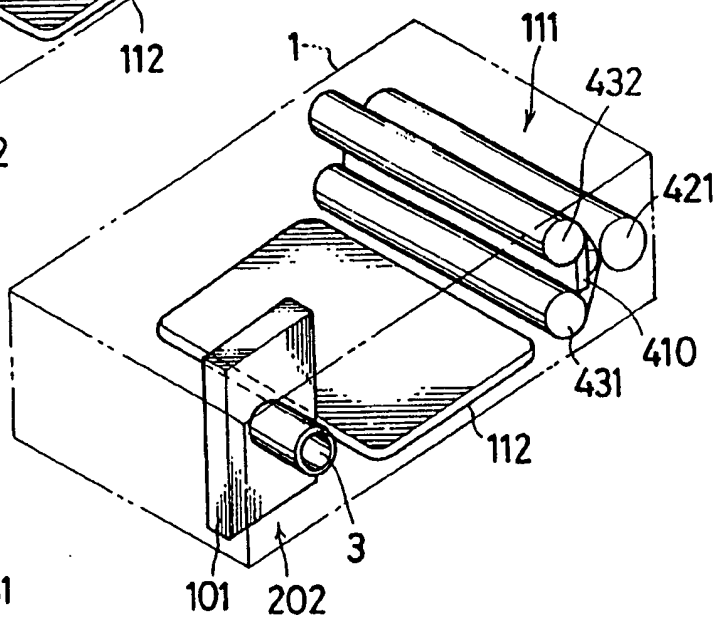
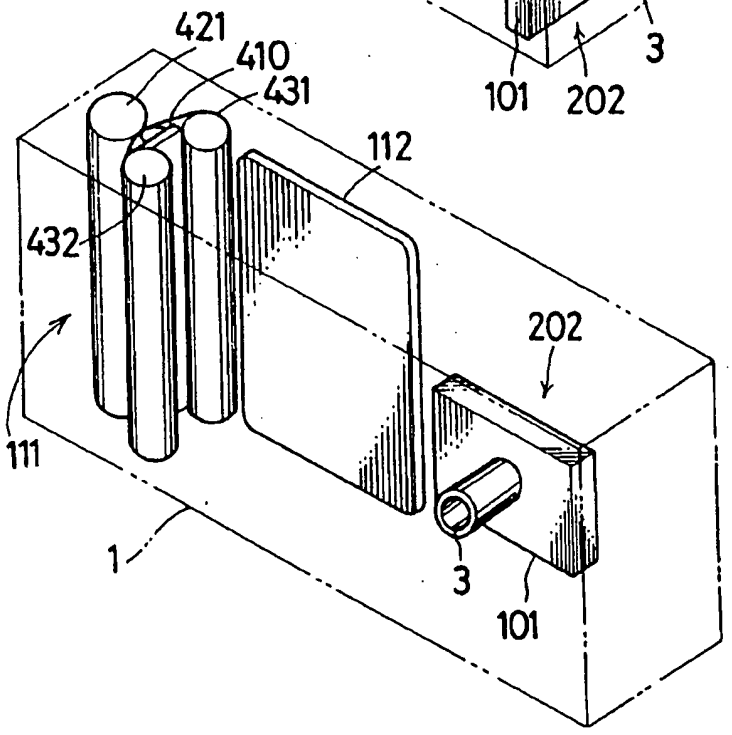


FIG. 30



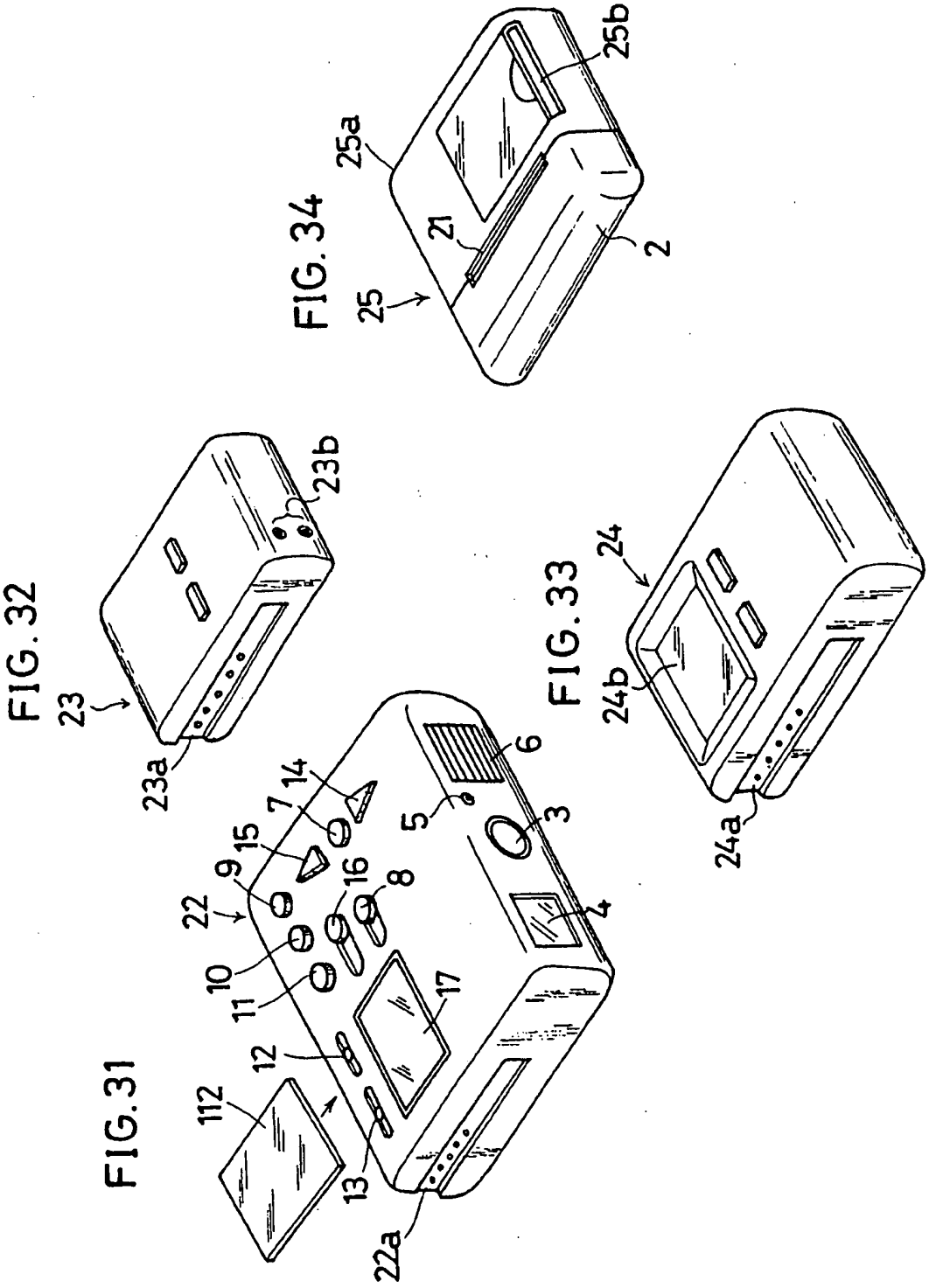


FIG. 34
25b
25a
21
2
25
FIG. 32
23
23b
23a
FIG. 33
24
24b
24a
FIG. 31
112
22
22a
6
5
3
4
7
14
15
9
16
8
10
11
12
13
17

FIG. 35

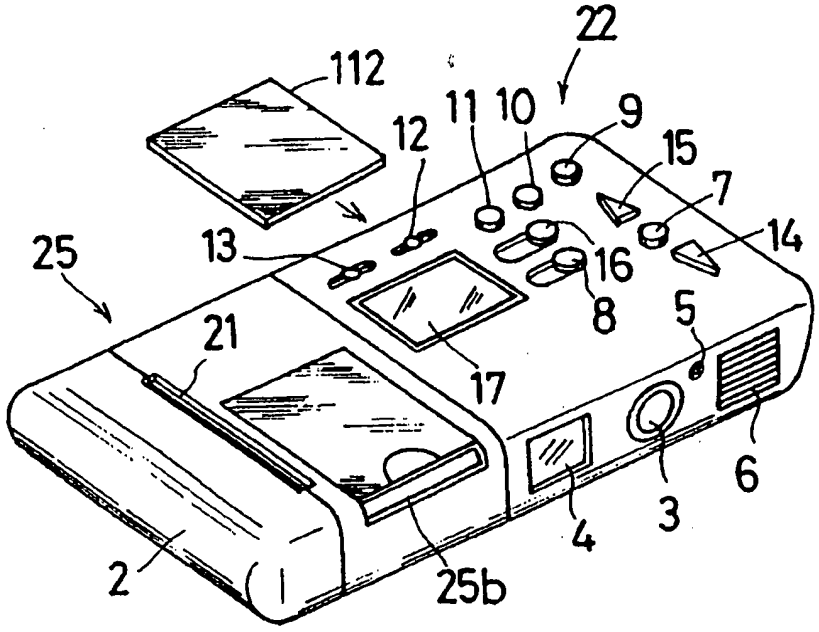

22
112
11
10
9
12
15
7
13
14
25
16
8
5
21
17
6
3
4
2
25b

FIG. 36

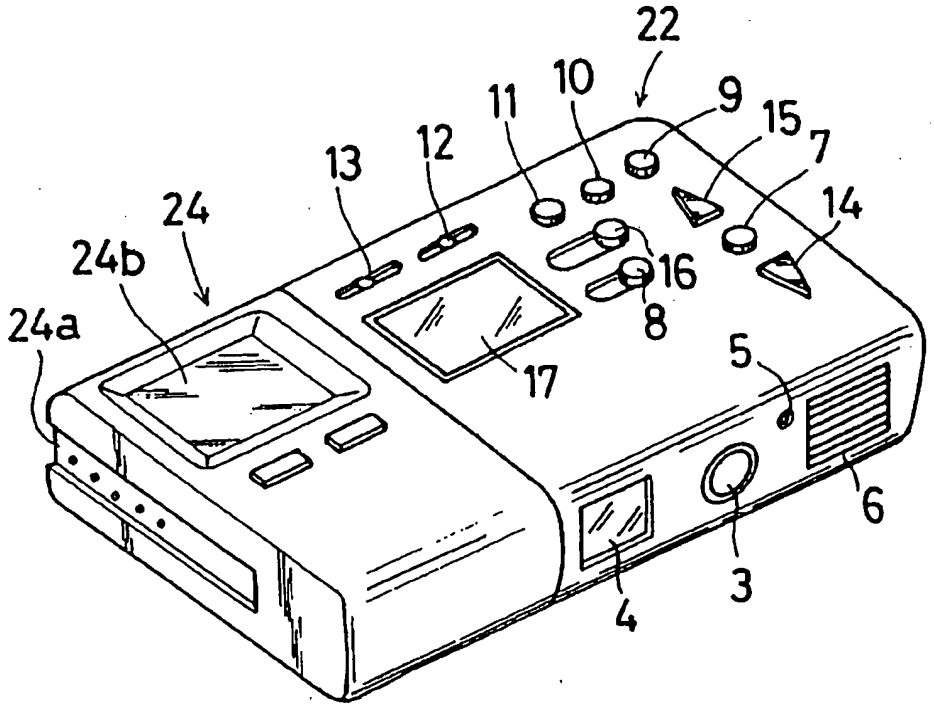

22
11
10
9
15
7
13
12
14
24
24b
16
8
24a
5
17
6
3
4

FIG. 37

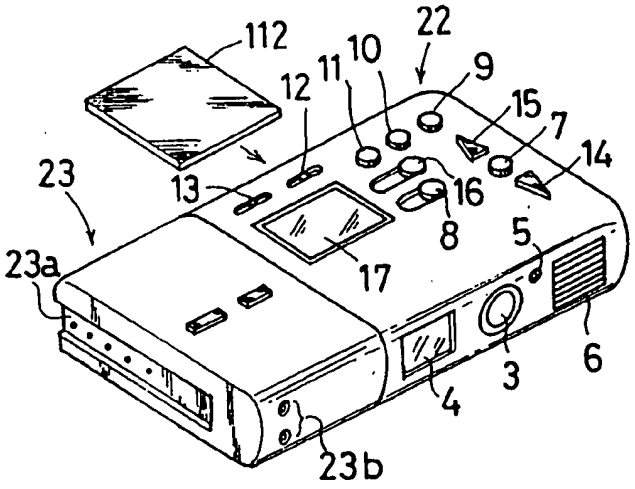
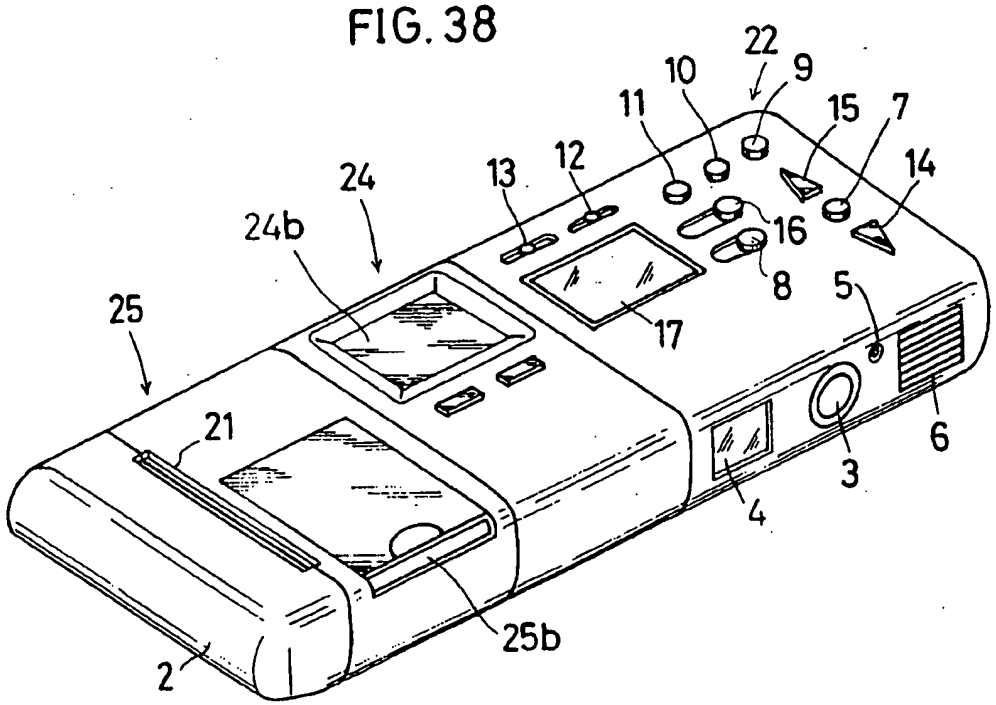

112
22
10
11
12
9
15
7
14
23
13
16
8
5
17
23a
3
6
4
23b

FIG. 38


22
9
10
11
15
7
14
24
13
12
24b
16
8
5
25
17
21
6
3
4
25b
2

STILL VIDEO CAMERA HAVING A PRINTER CAPABLE OF PRINTING A PHOTOGRAPHED IMAGE IN A PLURALITY OF PRINTING MODES

This application is a continuation of application Ser. No. 07/800,584, filed Nov. 27, 1991 abandoned.

BACKGROUND OF THE INVENTION AND RELATED ART STATEMENT

This invention relates to a still video camera, particularly to a still video camera capable of reproducing a photographed image at a photographing spot with the use of a printer or TV.

There has been conventionally known a still video camera which converts a light image into an electric signal with the use of a photoelectric conversion element and stores image information electrically. An image photographed by this still video camera can be readily reproduced any time after the photographing operation with the use of a TV reproduction device or a printer. In view of this, it has been recently designed to produce a multifunction still video camera with a TV reproduction device, a printer, or like device provided therein so as to increase added value thereof and attain higher quality.

For example, Japanese Unexamined Patent Publication No. 61-189785 discloses a still video camera provided with a built-in printer and a roll of recording sheet therein and capable of printing a stored image on the recording sheet. Also, Japanese Unexamined Patent Publication No. 1-204575 discloses a still video camera including a reproduction/display unit removably attachable to a camera main body in which a stored image can be reproduced in the reproduction/display unit.

Further, Japanese Unexamined Patent Publication No. 2-26771 discloses a thermal printing device having two print modes of the sublimation type and the melt-out type, the print mode being changeable one over the other, in which a color image is printed in the selected print mode.

In the camera provided with a printer disclosed in JPP No. 61-189785 or commercially available, one type of print mode, for example, a thermal transfer mode, is adopted. However, this camera neither teaches a concept of changing a print mode from one to the other, nor has a construction for that purpose accordingly.

The thermal printing device disclosed in JPP No. 2-26771 is capable of printing mainly the color image of a computer, and is not directly pertinent to a camera. Accordingly, the device has no such a construction as to be incorporated into the camera.

Also, the above thermal printing device having two changeable print modes is only capable of selecting a recording sheet corresponding to an ink ribbon mounted thereto, or displaying an indication indicative of absence of recording sheet in the case where the corresponding recording sheet is not mounted therein. However, this device does not determine compatibility of the ink ribbon and the recording sheet.

The camera provided with a printer disclosed in JPP No. 61-189785 or commercially available prints the photographed image on the rolled recording sheet provided in the camera. However, this camera does not have a printer whose construction allows the photographed image to be printed on an external recording sheet.

It is convenient to provide a printer capable of printing the image also on the external recording sheet in a camera main body since various print modes can be used depending on the applications. However, in the printer capable of printing the image on the external recording sheet, in the case where the recording sheet is not placed properly relative to a printer head, a printing position may be dislocated. Particularly, in case of color printing, respective color images may not be superimposed properly one over another.

Further, if a printer is capable of printing a stored image freely on plain paper of an unspecified size, it will increase readiness for confirmation and easy recording of photographed images, and recording sheet costs can be reduced, thereby further improving convenience of a printing function of a camera-provided with a built-in printer. However, in the camera provided with a printer disclosed in JPP No. 61-189785 or commercially available, the photographed image is recorded on the rolled recording sheet provided in the camera, and therefore the type and the size of recording sheet is subject to limitation. Further, in the case where a melting transfer print mode is adopted, the image can be printed on plain paper. However, in the existing camera provided with a built-in printer, the recording sheet in use is limited to a rolled sheet of a specified size, and accordingly the image cannot be printed freely on plain paper of an unspecified size.

Moreover, some of the cameras provided with a built-in printer include a storage capacity for storing image data for one frame and a printer for printing the stored image any time. Some include a memory capable of storing image data for a plurality of frames and a printer for printing the desired stored image(s) when it is necessary.

Japanese Unexamined Patent Publication No. 64-868 discloses a digital still camera including a semiconductor memory for storing a plurality of frames of photographed images.

Further, Japanese Unexamined Patent Publication No. 2-21482 discloses a still image transfer system in which a plurality of still images are read out of a first storage medium and outputted to TV as a multi-image on a picture screen, from which desired still images are selected, and the selected still images are transferred from the first storage medium to another one.

The camera provided with a built-in printer disclosed in JPP No. 61-189785 is capable of storing the image data only for one frame, and therefore cannot output a multi-image.

The digital still camera disclosed in JPP No. 64-868 includes the semiconductor memory for storing image data for more than one frame. However, this camera is not provided with a printer for printing the images stored in the memory.

Further, the above still image transfer system is designed to facilitate transfer of the stored images from one storage medium to the other, and does not relate to a camera provided with a built-in printer capable of printing the photographed image.

It has been considered to provide peripheral devices such as a printer unit, a TV reproduction unit, and a CRT display unit in a main body of a still video camera in order to produce a multifunction camera. However, this makes the camera larger and heavier, which in turn reduces operability of the camera during the photographing operation. Also, there are a variety of reproduction devices for reproducing the stored images. However, it is uneconomical to provide such devices which are not normally in use. Accordingly, in a still video camera, it is more practical to form an image

forming function, TV reproduction function, display function, and printing function respectively into units which can be generally and widely used, and combine some of these units according to needs to be systemized into a camera.

The still video camera disclosed in JPP No. 61-189785 is a camera provided integrally with a printer, and does not teach a concept of forming a systematic camera from units. Also, in JPP No. 1-204575, the display function is formed into the display unit removably attachable to the camera main body. However, this document neither teaches formation of the printing function into a unit, nor indicates a concept of systemizing the still video camera.

In a still video camera, a photographed image is converted into an electric signal and stored in a storage medium electrically or magnetically, obviating the need for providing a film take-up device as in a silver-salt camera. Therefore, an interior of the camera can be designed more freely. In a still video camera disclosed in Japanese Unexamined Patent Publication No. 1-186069, an external recording medium mounting portion is provided between an image forming section in which an optical system of the camera is arranged, and a release section in which operation buttons and the like of the camera are arranged. It is thereby designed to make the camera smaller-sized and utilize the space in the camera main body effectively.

In the case where a printer of the thermal transfer type or heat sensitive type is incorporated into the still video camera, the image forming section is adversely affected by the heat generated from a printer head at the time of printing. Accordingly, it is preferable to provide the image forming section including a photoelectric conversion element as far away from the printer as possible.

However, in the still video camera with the built-in printer disclosed in JPP No. 61-189785, the printer section is provided below the image forming section. This suggests the likelihood that the image forming section is adversely affected by the heat generated from the printer section, and thereby the photographed image is deteriorated.

Further, in the camera disclosed in JPP No. 1-186069, the image forming section and the release section are spaced away from each other by providing the external recording medium mounting portion therebetween. However, this arrangement is designed only to utilize the space in the camera main body effectively. This document does not disclose any arrangement in order to solve the aforementioned drawback in the case where the printer is provided internally in the camera main body.

It is an object of the present invention to provide a still video camera which has overcome the foregoing drawbacks.

SUMMARY OF THE INVENTION

Accordingly, a camera of the present invention comprises means for photographing an object, printing means for printing a photographed image of the object, said printing means having a plurality of selectable printing modes, image data provision means for processing the photographed image to a plurality of sorts of image data corresponding to the plurality of selectable printing modes respectively, and supplying the image data to said printing means, selection means for selecting a desired printing mode of said printing means, and controller means responsive to said selection means for controlling said image data provision means so as to provide the sort of image data suitable for the selected printing mode to said printing means.

Also, a camera of the present invention comprises means for photographing an object, printing means for printing a photographed image of the object, said printing means having a plurality of selectable printing modes, paper feeder means for feeding print paper to said printing means, selection means for selecting a desired printing mode of said printing means, and controller means responsive to said selection means for controlling said paper feeder means so as to feed the print paper under a feeding condition suitable to the selected printing mode.

Further, a camera of the present invention comprises means for photographing an object, printing means for printing a photographed image of the object, said printing means having a first portion for carrying an ink ribbon and a second portion for carrying print paper, and having plurality of printing modes, first detector means for detecting whether an ink ribbon is carried or not, second detector means for detecting whether print paper is carried or not, and determining means for determining a printing mode based on the detection result of said first and second detector means.

Furthermore, a camera of the present invention comprises means for photographing an object, printing means for printing a photographed image of the object, said printing means having a first portion for carrying an ink ribbon and a second portion for carrying print paper, and having a plurality of printing modes, first detector means for detecting what kind of ink ribbon is carried by the first portion, second detector means for detecting what kind of print paper is carried by the second portion, and determining means for determining a printing mode based on the detection result of said first and second detector means.

Moreover, a camera of the present invention comprises means for photographing an object, printing means for printing a photographed image of the object, said printing means having a first portion for carrying an ink ribbon and a second portion for carrying print paper, and having a plurality of printing modes, first detector means for detecting what kind of ink ribbon is carried by the first portion, second detector means for detecting what kind of print paper is carried by the second portion, discriminating means for discriminating what combination of ink ribbon and print paper is carried by said printing means based on the detection result of said first and second detector means, and controller means responsive to said discriminating means for controlling said printing means.

The above and other objects, features and advantages of the present invention will become more apparent upon a reading of the following detailed description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram showing a still video camera provided with a built-in printer embodying the invention;

FIG. 2A is a diagram showing power supply relationship of a power supply unit of the camera;

FIG. 2B is a diagram showing control lines between a CPU and a DC/DC converter;

FIG. 2C is a diagram showing supply relationship of the power supplied to a camera section;

FIG. 3A is a perspective view showing the camera of the invention;

FIG. 3B is a diagram showing an arrangement of a memory card mounting portion, an image forming section, and printer section of the camera;

FIGS. 4A, 4B, and 4C are detailed block diagrams combinedly showing a signal processing unit;

FIG. 5 is a block diagram showing a printer section;

FIG. 6 is a front view in section of the printer section;

FIG. 7 is a sectional view taken along the line VII—VII in FIG. 6;

FIG. 8 is a sectional view taken along the line VIII—VIII in FIG. 6;

FIG. 9 is a diagram showing a configuration of an ink ribbon of the sublimation type;

FIG. 10 is a diagram showing a configuration of an ink ribbon of the melt-out type;

FIG. 11 diagram showing a recording sheet of the is a sublimation type with markers affixed to specified positions thereon;

FIG. 12 is a diagram showing a recording sheet of the thermal type with markers affixed to specified positions thereon;

FIG. 13 is a diagram showing an ink ribbon of the hand scanning type;

FIG. 14 is a plan view in section showing a construction of the printer section used for printing an image on a precut recording sheet;

FIG. 15 is a plan view in section showing a construction of the printer section for use in a hand scanning mode;

FIG. 16 is a plan view in section showing a construction of the printer section used for printing an image on a roll of thermal recording sheet;

FIG. 17 is a diagram showing a modified recording sheet inlet according to the invention;

FIG. 18 is a circuit diagram of a thermal head;

FIG. 19 is a timing chart showing input timings of print signals in a melting transfer or a hand scanning mode;

FIG. 20 is a timing chart showing input timings of print signals in a sublimation or a thermo-sensitive mode;

FIG. 21 is a timing chart showing a time-divided driving of the thermal head;

FIGS. 22A and 22B are flow charts combinedly showing a main routine of the camera;

FIG. 23A and 23B are flow charts combinedly showing a "S1 ROUTINE";

FIG. 24 is a flow chart showing an "EXPOSURE ROUTINE";

FIG. 25A and 25B are flow charts combinedly showing a "REPRODUCTION ROUTINE";

FIGS. 26A to 26E are flow charts combinedly showing a "PRINT ROUTINE";

FIG. 27 is a perspective view of a camera provided with a built-in printer embodying the invention as a second embodiment;

FIGS. 28 to 30 are diagrams respectively showing arrangements of a memory card mounting portion, an image forming section, and a printer section;

FIG. 31 is a perspective view showing a camera unit;

FIG. 32 is a perspective view showing a TV reproduction unit;

FIG. 33 is a perspective view showing a display unit;

FIG. 34 is a perspective view showing a printer unit;

FIG. 35 is a perspective view showing a state in which the printer unit is connected to the camera unit;

FIG. 36 is a perspective view showing a state in which the display unit is connected to the camera unit;

FIG. 37 is a perspective view showing a state in which the TV reproduction unit is connected to the camera unit; and

FIG. 38 is a perspective view showing a state in which the camera unit, display unit, and printer unit are connected.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

FIG. 3A is a perspective view showing a still video camera provided with a built-in printer of the present invention.

In FIG. 3A, indicated at 1 is a camera main body, and at 2 a printer case removably attachable to the camera main body 1 and having a construction necessary for a printing operation to be described hereinafter incorporated therein. On a front portion of the camera main body 1 are provided a taking lens 3, a viewfinder 4, an autofocus projector (hereinafter referred to as an AF projector) 5, a light emission window of an electronic flash 6, and a release/print start button 7. The AF projector 5 is adapted for projecting the light on an object so as to automatically detect an object distance.

On an upper face of the camera main body 1 are provided various kinds of operable members as follows. An operation mode changeover switch 8 is adapted for changing one operation mode to another among the following four modes, "OFF" mode, "RECORD" mode, "REPRODUCTION" mode and "PRINT" mode. A protect switch 9 is adapted for preventing already stored images from being inadvertently erased by an operator. A multi-image output switch 10 is adapted for outputting a plurality of stored images as one multi-image. A flash mode changeover switch 11 is adapted for changing one flash mode to another among the following three modes, "non-flash (OFF) mode," "automatic flash (AUTO) mode," "forcible flash (ON) mode." A date setting switch 12 is adapted for allowing a state where a photographing date can be set. A photographing mode changeover switch 13 is adapting for changing a photographing mode from one photographing mode to another among the following three modes. "SINGLE" mode, "SELF-TIMER" mode and "CONTINUOUS" mode each time it is turned on. "SINGLE" mode is a photographing mode in which a single frame of photograph is obtained each time the release start button 7 is pressed. "SELF-TIMER" mode is a photographing mode in which the photographing operation is executed with the use of a self-timer. "CONTINUOUS" mode is a photographing mode in which a plurality of frames of photographs are continuously obtained at a predetermined speed while the release start button 7 is pressed. A forward access button 14 is adapted for advancing (UP) stored images one by one each time it is turned on. A reverse access button 15 is adapted for reversing (DOWN) the stored images one by one each time it is turned on. A macro/binary photographing mode changeover switch 16 is slidable in a lateral direction of the camera and adapted for changing from a macrophotographing mode to a binary photographing mode, and vice versa by being slid. An indicator 17 comprises, for example, a liquid crystal display (LCD), and is adapted for displaying a date, a frame number in a photographing or printing operation, and other set modes thereon. A memory card inlet 18 is formed in the shape of a slit, and adapted for inserting an external storage medium (hereinafter referred to as a memory card) to the camera main body 1 therethrough. Television (TV) output terminals 19 are provided in specified positions on a front surface of the camera main body body 1. A printer case detaching button

20 is operated so as to detach the printer case 2. A recording sheet inlet 21 is adapted for introducing therethrough a precut recording sheet into a printer provided in the printer case 2.

FIG. 3B shows an arrangement of a memory card mounting portion, a printer section 111, an image forming section 202 provided in the camera main body 1. The memory card mounting portion is provided substantially between the printer section 111 and the image forming section 202. With this arrangement, the space within the camera main body can be effectively utilized. In addition, it can be prevented that the heat generated by the printer section 111 adversely affects the image forming section 202.

FIG. 1 is a block diagram showing an overall construction of the camera.

A system controller (hereinafter referred to as CPU) 100 is adapted for controlling overall operations of the camera, including the printing operation. An object image formed through the taking lens 3 is picked up by a solid photoelectric conversion element (hereinafter referred to as CCD) 101 to be converted into an image signal. The image signal is sent from the CCD 101 to a signal processing unit 102 to be processed therein. The signal processing unit 102 will be described more in detail below. A lens driving unit 103 is adapted for controllably moving the taking lens 3 so as to attain an in-focus condition based on a measured object distance. A distance measuring unit 104 is adapted for measuring a distance to an object by using, for example, a phase difference detecting method. Based on the measured distance is calculated a driven amount of the taking lens 3 by the lens driving unit 103. A light measuring unit 105 is adapted for measuring luminance of the light illuminating the object and sending data representative of the measured luminance of the object to the CPU 100. An exposure controller 106 is adapted for executing an exposure control of the camera upon receipt of an exposure time (shutter speed) Tv and an aperture value Av from the CPU 100, both of which are obtained based on the measured object distance and the measured luminance of the object. A display unit 107 comprises the indicator 17 and a device for driving the indicator 17. An electronic flash device 108 is controlled in accordance with a booster control signal and a flash control signal for charging from the CPU 100, and emits flash light through the light emission window. A power supply unit 109 is adapted for supplying a high voltage of a predetermined level to the CCD 101, and a lower voltage of a predetermined level to other individual circuit elements. The power supply unit 109 will be described more in detail below. A battery checking circuit (hereinafter referred to as a BC circuit) 110 is connected to a main battery EB provided in the power supply unit 109, and adapted for checking the amount of power source in the main battery EB. The result of the battery checking is outputted to the CPU 100. The printer section 111 is controllably driven by the CPU 100, and adapted for printing an image on a recording sheet upon receipt of the image signal from the signal processing unit 102. The printer section 111 will be described more in detail below. A memory card 112 is a storage medium comprising, for example, a static random access memory (SRAM) and capable of storing a plurality of images. The memory card 112 is removably attachable to the camera main body 1. Indicated at Vout is a terminal corresponding to the TV output terminal 19.

Next, there will be described switches Soff to Smode.

Soff: A switch Soff is turned on when the operation mode changeover switch 8 is in the "OFF" mode position, to prohibit any camera operation.

Srec: A switch Srec is turned on when the operation mode changeover switch 8 is in the "RECORD" mode position, to enable a photographing operation.

Srep: A switch Srep is turned on when the operation mode changeover switch 8 is in the "REPRODUCTION" mode position, to enable a reproduction operation.

Spri: A switch Spri is turned on when the operation mode changeover switch 8 is in the "PRINT" mode position, to enable a printing operation of the stored images.

S1: A switch S1 is turned on when a release/print start button 7 is pressed halfway, to prepare for the photographing operation.

S2: A switch S2 is turned on when a release/print start button 7 is pressed all the way, to execute an exposure operation in the "RECORD" mode.

It should be noted that the switch S1 and the switch S2 are turned on to prepare for the printing operation and execute the printing operation in the "PRINT" mode respectively.

Sup: A switch Sup is turned on each time the forward access button 14 is pressed, to sequentially reproduce the stored images in a forward order.

Sdown: A switch Sdown is turned on each time the reverse access button 15 is pressed, to sequentially reproduce the stored images in a reverse order.

Spro: A switch Spro is actuated each time the protect switch 9 is pressed. The switch Spro is turned on to protect the stored images while being turned off to release protection of the stored images.

Smal: A switch Smal, corresponding to the multi-image output switch 10, is turned on to enable a multi-image output.

Smac: A switch Smac is a macrophotographing switch which is turned on when the macro/binary photographing mode changeover switch 16 is depressed, to enable macrophotography by inserting and placing an unillustrated macro lens on an optical axis.

Smono: A switch Smono is a binary photographing switch which is turned on when the macro/binary photographing mode changeover switch 16 is slid while being depressed, to enable character photographing or the like.

Scard: A switch Scard is turned on when the memory card is mounted to the camera main body 1.

Sfl: A switch Sfl is turned on when the flash mode changeover switch 11 is pressed, to cylically change from one flash mode to another among "OFF" mode, "AUTO" mode, and "FORCIBLE ON" mode.

Sadj: A switch Sadj is a switch corresponding to the date setting switch 12.

Smode: A switch Smode is turned on each time the photographing mode changeover switch 13 is pressed, to cyclically change from one photographing mode to another among "SINGLE" mode, "SELF-TIMER" mode, and "CONTINUOUS" mode.

FIG. 2A, 2B, and 2C respectively show power supply relationship between the individual elements in the camera provided with a built-in printer. FIG. 2A is a diagram showing a construction of the power supply unit 109 and power supply relationship thereof with other elements. FIG. 2B is a diagram showing control lines between the CPU 100 and a direct current/direct current (DC/DC) converter 200. FIG. 2C is a diagram showing power supply relationship in a camera section 203.

In FIGS. 2A, 2B, indicated at EB is the main battery, and at EC is a back-up battery for backing up the camera section

203, a memory 204 provided in the camera main body 1, and the memory card 112. The memory 204 corresponds to memories 311, 312 shown in FIG. 4B. The DC/DC converter 200 is adapted for producing various voltages and supplying the same to the printer section 111, an image forming section 202, and the camera section 203 in accordance with a control signal Dcon from the CPU 100. The DC/DC converter 200 produces and supplies a high voltage E1, e.g., 24V, to the printer section 111 so as to drive a printer head provided therein. The DC/DC converter 200 produces and supplies a voltage E2, e.g., 15V, to the image forming section 202 so as to drive the CCD 101 provided therein. The DC/DC converter 200 produces and supplies a voltage E3 to the camera section 203 so as to drive the taking lens 3 or the like. The control signal Dcon consists of two bits, and is sent from the CPU 100 to the PC/PC converter 200 through two control lines provided therebetween as shown in FIG. 2B.

Table-1 below shows respective commands represented by the control signal Dcon. When the control signal Dcon is "00," it renders the DC/DC converter 200 inoperative, and thereby a drive voltage is not supplied to any of the printer section 111, image forming section 202. and camera section 203. When the control signal Dcon is "01," it renders the DC/DC converter 200 to produce the voltage E3 and supply the same only to the camera section 203. When the control signal Dcon is "10." it renders the PC/PC converter 200 to produce the voltages E2, E3 and supply the same to the image forming section 202, and the camera section 203 respectively. When the control signal Dcon is "11." it renders the PC/PC converter 200 to produce the voltages E1, E3 and supply the same to the printer section 111, the camera portion 203.

TABLE 1

Dcon	PRINTER SEC.	IMAGE FORMING SEC.	CAMERA SEC.
00	X	X	X
01	X	X	O
10	X	O	O
11	O	X	O

X: OFF, O: ON

Referring back to FIG. 2A, indicated at 201 is a power regulator for regulating the power supplied from the main electric battery EB to a voltage of, e.g., 5V and supplying the regulated voltage to the CPU 100, indicator 107 or the like provided in the camera section 203 so as to drive it. In addition, the power regulator 201 supplies the regulated voltage to the memory 204 and the memory card 112 provided in the camera main body 1. The power is supplied to the flash device 108 directly from the main battery EB. The supplied power is used for charging a main capacitor C or other purposes.

As will be seen from FIG. 2C, the power is supplied from the power regulator 201 to a liquid crystal portion of the indicator 107 and the CPU 100, both of which can be driven at a low voltage and consume relatively small power. The power is supplied from the DC/DC converter 200 to a portion of the CPU 100, the distance measuring unit 104, the light measuring unit 105, the exposure controller 106, and portion of the indicator 107, any of which has a relatively large power consumption. The power is supplied from the main battery EB to the lens driving unit 103 having a large power consumption.

FIGS. 4A, 4B are block diagrams combinedly showing the signal processing unit 102 in detail.

In FIG. 4A, the CCD 101 is a color photoelectric conversion element having striped filters of red (R), green (G), and blue (B) and is driven by a CCD driver 301. A CCD-TG 302 is a timing generator for supplying a control signal and a control pulse to individual circuits in the signal processing unit 102 in accordance with a control signal from the CPU 100. The CCD-TG 302 sends clocks ϕv, ϕh to the CCD driver 302 to cause it to drive the CCD 101 to send an image signal to a CDS 303 to be described below. The CCD driver 301 controls the start of charging and reading out of the stored charges of the CCD 101. In this way, the CCD controls the amount of stored charges. Further, the CCD-TG 302 sends a timing pulse to the CDS 303 and clock pulses CK to other circuits. The CDS 303 is adapted for executing sampling so as to apply double correlation to the image signal from the CCD 101. A gain controller (GC) 304 is adapted for adjusting the gain of the image signal. The image signal having the gain thereof adjusted is sent to an analog/digital (A/D) converter 305 to be converted from an analog signal to a digital signal. A white balance (WB) correction circuit 306 is adapted for performing WB correction to the digital image signal in accordance with color temperature or color balance data received from an unillustrated WB sensor through the use of a predetermined conversion table. A γ correction circuit 307 is adapted for performing γ correction further to the image signal sent from the WB correction circuit 306 through the use of a predetermined conversion table so as to correct gradation of the image signal. A processing circuit 308 and a matrix circuit 309 are respectively adapted for generating respective color image signals of R, G, and B (hereinafter referred to as a R-signal, a G-signal, and a B-signal respectively) from the image signal.

In FIG. 4B, memories 311, 312 are adapted for storing the R-, G-, and B-signals from the matrix circuit 309, and have storage capacity of at least one frame of image respectively. An address generator 310 is adapted for generating and outputting control signals required for an image writing-in or reading-out operation, such as a chip select signal and a read-out address, in cases such as when the image signal from the CCD 101 is to be written in the memories 311, 312, the image signal is to be read out of the memories 311, 312, and the image signal is to be written in or read out of the memory card 112.

A signal compression/expansion circuit 313 is adapted for determining whether the image signal is to be written in read out of the memory card 112, and, based on the determination, compressing the respective signals when the image signal is to be written in the memory card 112 and expanding the compressed signals read from the memory card 112 to the original image signal when the image signal is read out of the memory card 112. The image signal is converted into a low band luminance signal Y and a color difference signal C when written in the memory card 112. The image signal is sent between the memory card 112 and the CPU 100, address generator 301, and signal compression/expansion circuit 313 through an interface (hereinafter referred to as card I/F) 314. A signal processing circuit 315 for TV output is adapted for applying a processing to an image signal sent thereto in accordance with a reproduction write clock so as to be outputted to the TV. A processed video signal is stored in an unillustrated video memory provided in the TV output signal processing circuit 315. The TV output signal processing circuit 315 generates a low band luminance signal Y and a color difference signal C from the respective R-, G-, and B-signals. Digital/analog (D/A) converters 316, 317 are adapted for respectively converting the digital low band luminance signal Y and color difference signal C read out of the video memory in the TV output signal processing circuit 315 into an analog low band luminance signal Yout and an

analog color difference signal Cout, and outputting the same to an unillustrated TV through a TV output terminal **19**. An oscillator **318** is adapted for generating a read-out clock for reproduction, and generating and sending output clock signals to the D/A converters **316**. **317**. A controller **319** for multi-image reproduction is adapted for generating a multi-image to be reproduced. The reproduced multi-image temporarily stored in a multi-image memory **320**.

Next, there will be described an operation of the aforesaid block in a photographing/recording operation, a recording operation to the memory card, a TV reproduction operation, a printing operation, and a multi-image processing respectively.

(1) Photographing/Recording Operation

When the release/print start button **7** is pressed with the operation mode changeover switch **8** being in a "RECORD" mode, the CPU **100** sends a CCD control signal to the CCD-TG **302** so as to control an exposure time of the CCD **101**. More specifically, the CPU **100** drives the light measuring unit **105** to measure the luminance of the light, calculates an aperture value Av and an exposure time Tv based on the measured light, and controls a diaphragm in accordance with an aperture value Av. The CPU **100** further sends the CCD control signal to the CCD-TG **302** according to the exposure time TV. In a camera which effects an exposure operation continuously twice by swinging the CCD **101** by a half pitch of the element of the CCD in order to obtain higher resolution as disclosed in Japanese Unexamined Patent Publication No. 59-174085, the CPU **100** controls the exposure time of the respective exposure operations.

During the exposure operation, the CPU **100** sends a memory select signal to the address generator **310** so as to select a memory in which image signals are to be written. Upon receipt of the memory select signal, the address generator **310** sends chip select signals **CS1**, **CS2** to the memories **311**, **312**. Further, the CPU **100** causes the address generator **310** to send read/write (R/W) signals respectively to the memories **311**, **312**, whereby enabling the image signal from the CCD **101** to be written in the memories **311**, **312**. Thereafter, it is started to read the image signals out of the CCD **101** upon completion of the exposure operation. The read out image signals are sequentially written in the selected memory in accordance with a write address generated based on a write start signal and a write clock WCK. Upon completion of writing of the image signals, the address generator **310** sends a write end signal to the CPU **100**, which in turn causes the image signal writing operation into the selected memory stop.

In the case where the image signals stored in the memory card **112** are to be written in any one of the memories **311**, **312**, the CPU **100** causes the address generator **310** to send the chip select signal CS1 or CS2 to the memory **311**, or **312**, thereby selecting either of the memory **311** or **312** in which the image signals are to be written. Thus, the image signals from the memory card **112** are written in the selected memory. Upon completion of writing of the image signals, the CPU **100** receives the write end signal from the address generator **310**, whereby causing to stop the image signal writing operation into the selected memory.

Further, if any instruction is manually given after the image signal writing operation, the CPU **100** enables the written image signals to be outputted to an output end according to the instruction to be described below.

(2) Recording Operation in the Memory Card

The image signals written in the memories **311**, **312** in a manner as described above can be transferred to the memory card **112** and stored therein if necessary. When confirming that the memory card **112** is selected as an output end of the image signals, the CPU **100** executes the following operations. Data administration/retrieval information, such as the number of frames in use, is read out of the memory card **112**. Based on the read out information, a write start address in the memory card **112** is determined. The image signals are read out either of the memory **311** or **312** in accordance with an output start signal, and sent to the signal compression/expansion circuit **313**.

After converting the image signals sent thereto into low band luminance signals Y and color difference signals C, the signal compression/expansion circuit **313** applies compression processing to the respective converted signals by adopting, for example, an adaptive discrete cosine transform (ADCT) method. The compressed low band luminance signals and color difference signals are written in the memory card **112** through the card I/F **314** in accordance with write addresses information from the address generator **310**. Upon completion of the writing operation in the memory card **112**, the address generator **310** sends an output end signal to the CPU **100**. Each time the CPU **100** receives the output end signal, the data administration/retrieval information is renewed.

(3) TV Reproduction

When the release/print start button **7** is pressed with the operation mode changeover switch **8** being in a "REPRODUCTION" mode, the CPU **100** selects the TV output signal processing circuit **315** as an output end of the image signals. Then, the image signals stored in the memory **311** or **312**, or the memory card **112** are read therefrom, and written in the unillustrated video memory provided in the TV output signal processing circuit **315** in the form of R-, G-, B-signals in accordance with a reproduction write clock from the address generator **310**. The TV output signal processing circuit **315** converts the R-, G-, B-signals written in the video memory into a low band luminanee signal Y and a color difference signal C. In addition, the TV output signal processing circuit **315** adds a burst signal, horizontal and vertical synchronizing signals, and other signals onto the respective low band luminanee signal Y and color difference signal C so as to produce a standard television signal such as an NTSC video signal. The produced video signal is written in the video memory in the TV output signal processing circuit **315** again. After all the video signals are written in the video memory, the video signals in the video memory are repeatedly read out at a predetermined interval in accordance with a reproduction clock from the generator **318**, and then converted into analog video signals by the D/A converters **316**, **317**. The converted analog video signals are outputted to the unillustrated TV through the TV output terminal **19**. As a consequence, the photographed image is displayed on TV as a still image.

(4) Printing Operation

The printing operation of the stored image signals are executed in the printer section **111** shown in FIG. **5**.

When the release/print start button **7** is pressed with the operation mode changeover switch **8** being in a "PRINT" mode, the CPU **100** executes the following operations. The image signals stored in the memory **311** or **312**, or the memory card **112** are read therefrom in accordance with the read-out clock from the address generator **310**, and sent to a data converting circuit **321** for a printer. At this time, the CPU **100** confirms a state of the printer section **111** according to control data inputted thereto by way of a system bus

SB, and controls the printer section **111** based on the confirmed state. Thereafter, data represented by the image signals is converted in the print signal converting circuit **321** in accordance with a desired print system to be described below, and then introduced to a thermal head **410** to be printed out. A print signal is representative of data to be printed. The printing operation will be described more in detail later.

(5) Multi-Image Processing

The CPU **100** is also programmed to execute multi-image processing, so that the image signals stored in the memory **311** or **312**, or the memory card **112** can be reproduced on TV printed out as a multi-image.

When the image signals are to be reproduced on TV as a multi-image, the multi-image reproduction controller **319** sets the number of frames of images in a picture plane displaying the multi-image at first. The image signals to be displayed as a multi-image are sequentially selected out of the memory **311** or **312**, or the memory card **112** in the order of display positions and written in corresponding storage area in the multi-image memory **320**. In this case, sampling or filtering are performed to the selected image signals according to the size of the display so as to be desirably written in the predetermined storage area.

When all the image signals of the set number to be displayed on the picture plane (hereinafter referred to as multi-image signals) of the set number are written in the multi-image memory **320**, the CPU **100** selects a reproduction circuit, i.e., TV connected to the TV output terminal **19**, as an output end of the multi-image signals. Then, the multi-image signals are read out of the multi-image memory **320** in accordance with a read-out clock from the multi-image reproduction controller **319** and written in the video memory in the TV output signal processing circuit **315** in the form of R-, G-, and B-signals. After being written in the video memory, the multi-image signals are converted from the R-, G-, and B-signals into the low band luminance signals Y and the color difference signals C in accordance with the reproduction write clock, and then into the NTSC video signals as described above. The NTSC video signals are written in the video memory in the TV output signal processing circuit **315** again. When all the NTSC video signals are written in the video memory, the NTSC video signals are read out repeatedly at a predetermined interval in accordance with the reproduction clocks from the oscillator **318**, and converted from the digital video signals into analog video signals by the D/A converters **316**, **317** to be outputted to the unillustrated TV. Thus, the multi-images are displayed on TV as a still image.

On the other hand, when the multi-image is to be printed out, the multi-image signals are sent to the print signal converting circuit **321** shown in FIG. **5**, in which data represented by the multi-image signals is converted. Consequently, the converted data is introduced to the thermal head **410** to be printed out.

FIG. **5** is a block diagram showing a construction of the printer section **111**.

In FIG. **5**, indicated at **400** is a thermal head control circuit **400** for controlling an operation of a thermal head block **403**. The thermal head block **403** comprises a thermal head **410** for printing one line or several lines at one time and a thermal head pressing solenoid **411**. The thermal head pressing solenoid **411** is adapted for switching a position of the thermal head **410** between a printing position where the thermal head **410** is pressed against a platen roller **421** to be described below and a standby position.

A solenoid/motor driving circuit **401** is adapted for controllably driving the thermal head pressing solenoid **411** and a DC servo motor **420**. The DC servo motor **420** is adapted for drivingly rotating the platen roller **421** disposed oppositely to the thermal head **4210** and grip rollers **425** provided at opposite sides of the platen roller **421**, see FIG. **6**.

A sheet feed block **404** is adapted for feeding a recording sheet, and comprises a pair of nip rollers **412**, a rotation sensor **413**, and recording sheet sensors A **414**, B **415**. The pair of nip rollers **412** are provided rotatably bearing in contact with the grip rollers **425**. The rotation sensor **413** is adapted for detecting rotation of the nip rollers **412**. The recording sheet sensors A **414**, B **415** are adapted for discriminating a recording sheet of one type against that of another type.

An ink ribbon feed block **405** is adapted for taking up an ink ribbon, and comprises an ink ribbon **416**, leading end sensors A **417**, B **418** respectively for detecting leading end of respective ribbon segments of the ink ribbon **416** to be described more in detail below, and an ink ribbon sensor **419** for detecting whether the ink ribbon is set. The rotational force of the nip rollers **412** are transmitted to a shaft of a take-up reel for taking up the ink ribbon **416** through an unillustrated clutch or gear, whereby the ink ribbon **416** is taken up in synchronism with rotation of the nip rollers **412**.

A sensor signal input circuit **402** is a circuit to which are inputted sensor signals sent from the rotation sensor **413** and the recording sheet sensors A **414**, B **415** provided in the sheet feed block **404**, and the leading end sensors A **417**, B **418**, and the ink ribbon sensor **419** provided in the ink ribbon feed block **405**, and other sensors.

Next, there will be described an interior mechanism of the printer section **111**.

FIG. **6** is a view in a vertical section showing the printer section **111**. FIG. **7** is a sectional view taken along the line VII—VII in FIG. **6**. FIG. **8** is a sectional view taken along the line VIII—VIII in FIG. **6**.

In FIG. **6**, the platen roller **421** and the DC servo motor **420** for driving the platen roller **421** are provided in the printer case **2**. The platen roller **421** is arranged in such position as to oppose to the thermal head **410** when the printer case **2** is attached to a camera main body **1**. To an upper and a lower end portions of the platen roller **421** are fixed grip rollers **425** having many small protuberances formed on outer surfaces thereof. The grip rollers **425** are designed to rotate integrally with the platen roller **421**. Further, a gear **422** is attached to the platen roller **421** under the lower-positioned grip roller **425** in the plane of FIG. **6**. The gear **422** is coupled to a gear **423** of the DC servo motor **420** through a gear **424**. The platen roller **421** is drivingly rotated by the DC servo motor **420** through the gears **422** to **424**.

Other mechanisms necessary for the printing operation are provided in a case of the camera main body **1**.

The thermal head **410** is held slidably in directions indicated by arrows a in a container **426** in such a manner as to oppose to the platen roller **421**. Further, the thermal head pressing solenoid **411** is fixed to the container **426**. The solenoid **411** is coupled to the thermal head **410** in the container **426** through a plunger **427** thereof, a lever **428**, and a shaft **429**. The thermal head **410** is made slidable in the direction indicated by the arrows a by pivoting the lever **428** about a supporting point **430** thereof with the use of the thermal head pressing solenoid **411** and an unillustrated helical spring connected to the lever **428**. Thereby, the thermal head **410** is made movable between the pressing position and the standby position relative to the platen roller

421. More specifically, upon energization of the solenoid **411**, the thermal head **410** is held in the pressing position. On the contrary, upon deenergization of the solenoid **411**, the thermal head **410** is held in the standby position. Further, the container **426** has bearing structures formed at a right upper end and a right lower end thereof. The nip rollers **412** are rotatably mounted to the respective bearing structures with interposing the thermal head **410**. The nip rollers **412** bear in pressing contact with respective grip rollers **425**. Accordingly, the recording sheet can be accurately fed by the rotational forces of the grip rollers **425** and the nip rollers **412**.

The ink ribbon **416** is set stretchingly between a feed roller **431** and a take-up roller **432** with passing between the thermal head **410** and the platen roller **421** halfway as shown in FIG. **7**. It is discriminated by the ink ribbon sensor **419** whether the ink ribbon is set or not.

Referring back to FIG. **6**, a gear C is attached through a slide clutch **433** to a bottom portion of the take-up roller **432** on which the ink ribbon **416** is mounted. The gear C is further coupled to a gear A attached to the lower-positioned nip roller **412** through a gear B. The slide clutch **433** always causes the take-up roller **432** to rotate at a suitable speed irrespective of the speed at which the nip rollers **412** rotate, thereby taking up the ink ribbon **416** in a stable manner. The gear B is in mesh with the gear C when rotating in a direction indicated by an arrow f while being out of mesh with the gear C when rotating in a direction indicated by an arrow e in FIG. **8**. The rotational force of the nip rollers **412** is transmitted to the shaft of the take-up roller **432** only when the nip rollers **412** rotate in a direction indicated by an arrow g. More specifically, the printing operation is not executed when a recording sheet is fed in a direction indicated by an arrow b with the nip rollers **412** so as to set the recording sheet in a predetermined position. Thus, in this case, the rotational force of the nip rollers **412** is not transmitted to the shaft of the take-up roller **432** lest the ink ribbon should be taken up by the take-up roller **432**. On the other hand, the printing operation is executed when the recording sheet is fed in a direction opposite of the b-direction with the nip rollers **412**. Thus, in this case, the rotational force of the nip rollers **412** is transmitted to the shaft of the take-up roller **432**.

The gear A is coupled to a gear E attached to a slit plate **434** through a gear D. Accordingly, the slit plate **434** rotates together with the nip rollers **412**. Rotation of the slit plate **434**. i.e.. rotation of the nip rollers **412**, is detected by the rotation sensor **413**, which outputs a sensor signal representative of the detected rotation. Based on the sensor signal from the rotation sensor **413**, the thermal head **410** prints the image on the recording sheets according to the speed at which the recording sheet is fed, and the ink ribbon **416** is controllably taken up appropriately.

The ink ribbon **416** in use has a width equal to that of the thermal head **410**. FIG. **9** shows an example of an ink ribbon of the sublimation type. FIG. **10** shows an example of an ink ribbon of the melt-out type.

Both the sublimation type ink ribbon and the melt-out type ink ribbon have colored portions of three colors, namely, yellow, magenta, and cyan, arranged recurrently in this order from the take-up roller **432**, each colored portion having a predetermined length. One yellow portion, one magenta portion, and one cyan portion constitute a ribbon segment. Between a cyan portion and a yellow portion is provided a transparent portion **416*a*** indicative of a leading end of a ribbon segment. Further, to the transparent portion **416*a*** is affixed a black marker m, which indicates the type of the ink ribbon. For instance, in the sublimation type ink ribbon, the marker m is provided at a right end portion of the transparent portion **416*a*** with respect to a direction in which the ink ribbon is taken up, see FIG. **9**. In the melt-out type ink ribbon, the marker m is provided at a left end portion of the transparent portion **416*a*** with respect to the ink ribbon take-up direction, see FIG. **10**. Markers m provided at the left end portions of the transparent portions **416*a*** with respect to the ink ribbon take-up direction are detected by the leading end sensor A **417**. On the other hand, markers m provided at the right end portions of the transparent portions **416*a*** with respect to the ink ribbon take-up direction are detected by the leading end sensor B **418**. In accordance with sensor signals sent from the leading end sensors A **417**. B **418**, the type of the ink ribbon **416** in use is discriminated, and the leading end of the ribbon segment is fed to a predetermined position in the printing operation. More specifically, in the case where the marker m is detected by the leading end sensor A **417**, the ink ribbon in use is discriminated to be of the melt-out type. On the contrary, in the case where the marker m is detected by the leading end sensor B **418**, the ink ribbon in use is discriminated to be of the sublimation type.

It should be noted that the positions of the markers m are not limited to opposite end portions of the transparent portion **416*a***. The marker m may be provided in a position deviated from a center line of the ink ribbon **416** to the left or to the right. Further, a corresponding relationship between the position of the marker m and the type of the ink **416** is not limited to the foregoing one, but a desired corresponding relationship of these can be determined.

To a recording sheet is affixed a marker M in the form of a square indicative of the type of the recording sheet. FIG. **11** shows an example of a recording sheet of the sublimation type. FIG. **12** shows an example of a recording sheet of the thermal type. The marker M is affixed to a specified position of a rear surface of a recording sheet Pa. In the sublimation type recording sheet, two markers M are provided at opposite ends of a diagonal line extending from a left upper end to a right lower end of the recording sheet Pa. In the thermal type recording paper sheet, two markers M are provided at positions inward of opposite ends of a diagonal line by one marker with respect to a direction perpendicular an recording sheet inserting direction. In this embodiment, a marker M is not affixed to a recording sheet for the melt-out type ink ribbon. The recording sheet Pa may be label paper sheet to a rear surface of which a layer of adhesive is applied.

The markers M provided at the opposite ends of the diagonal line on the rear surface of the recording sheet are detected by the recording sheet sensor A **414**. On the other hand, the markers M provided at positions inward of opposite ends of a diagonal line by one marker with respect to the direction perpendicular to the recording sheet inserting direction are detected by the recording sheet sensor B **415**. The type of the recording sheet Pa is discriminated in accordance with the sensor signal sent from the recording sheet sensor A **414**, or B **415**.

It should be noted that the positions of the markers M are not limited to those specified above. The markers may be provided in desired positions on the rear surface of the recording sheet Pa. Further, a corresponding relationship between the positions of the marker M and the type of the recording sheet Pa is not limited to the foregoing one, but a desired corresponding relationship of these can be determined.

FIG. **14**, similar to FIG. **7**, is a diagram in section showing an interior mechanism of the printer section **111** where a monochromatic printing is executed on a precut recording sheet.

The ink ribbon **416** is removed from the construction for the color printing as shown in FIG. **7** to enable the printer section **111** to execute the monochromatic printing. More specifically, in the monochromatic printing, an image can be printed just by pressing the thermal head **410** directly against the thermal recording sheet. Accordingly, the printer **111** can serve as a monochromatic printer only if the ink ribbon **416** is removed therefrom. In the monochromatic printing, a roll of thermal sheet can be used in addition to precut ones. In this case, the roll **436** of thermal sheet may be mounted to the printer **111** instead of the ink ribbon **416** as shown in FIG. **16**, whereby the monochromatic printing becomes executable on the roll of recording sheet.

FIG. **15**, similar to FIG. **7**, is a diagram in section showing an interior mechanism of the printer section **111** when a hand scan printing is executed.

The printer case **2** carrying the DC servo motor **420** is removed from the camera main body **1** to enable the printer section **111** to execute the hand scan printing. There is no need for driving source, i.e., the DC servo motor **420**, so as to drive the nip rollers **412** in the hand scan printing. Further, since the image is printed in a monochromatic way in the hand scan printing, a melt-out type ink ribbon **416a** shown in FIG. **13** which is completely black is used. Since an entire surface of the melt-out type ink ribbon **416*a*** is black, the leading end sensors A **417**, B **418** respectively send the sensor signals all the time, whereby the ink ribbon in use is discriminated to be the melt-out type ink ribbon **16*a*** having a completely black surface.

Next, a printing operation of the printer section **111** will be described for the following three cases: 1) Color printing on a precut recording sheet. 2) Monochromatic printing on a precut recording sheet. 3) Printing by means of hand scanning.

(1) Color printing on a precut recording sheet

In FIG. **8**, when the recording sheet Pa is inserted through the recording sheet inlet **21** in a direction indicated by an arrow b, i.e., from a front face of the camera main body **1** to a rear face thereof, insertion of the recording sheet Pa and the type thereof are discriminated by the recording sheet sensors A **414** and B **415**. The DC servo motor **420** is drivingly rotated in a direction indicated by an arrow i upon receiving the sensor signals from the recording sheet sensors A, **414** and B **415**. Thereby, the grip rollers **425** are caused to rotate in a direction indicated by an arrow c. The inserted recording sheet Pa is held between the nip rollers **412** and the grip rollers **425**, and then further fed in the b-direction. At this stage, the thermal head pressing solenoid **411** is in a deenergized state, and accordingly the thermal head **410** is held in the standby position away from the platen roller **421**. In the case where the grip rollers **425** are rotated in the c-direction, the nip rollers **412** are rotated in a direction indicated by an arrow h. The rotational force of the nip rollers **412** is transmitted through the gear A to the gear B, which in turn rotates in a direction indicated by an arrow e. However, the gear B is not in mesh with the gear C when rotating in the e-direction. Accordingly, the take-up roller **432** is not rotated, and therefore the ink ribbon **416** is not to be taken up.

When it is detected that the recording sheet Pa is fed to a predetermined position based on the sensor signal from the rotation sensor **413**, the DC servo motor **420** is stopped. Thereafter, the thermal head pressing solenoid **420** is energized, whereby the thermal head **410** is pressed against the platen roller **421** with the ink ribbon **416** and the recording sheet Pa therebetween. Thereafter, the DC servo motor is driven in a direction indicated by an arrow j, and thereby the platen roller **421** is rotated in a direction indicated by an arrow d. Simultaneously, the thermal head **410** prints the image on the recording sheet Pa in synchronism with the speed at which the recording sheet Pa is fed, whereby an yellow image data is printed one line after another. During the printing operation, the rotational force of the nip rollers **412** is transmitted to the gear B, which is in turn rotated in the f-direction. Thereby, the gear B is coupled to the gear C. Consequently, the take-up roller **432** is rotated to take up the ink ribbon **416**.

Upon completion of printing of the yellow image, the thermal head pressing solenoid **411** is deenergized, whereby the thermal head **410** is slid to the standby position away from the platen roller **421**. Thereafter, the DC servo motor **420** is again driven in the i-direction to feed the recording sheet Pa in the b-direction up to the predetermined position. Thereupon, a magenta image data is printed on the recording sheet in a manner similar to the above. A cyan image data is printed after the magenta image data in the similar manner. In this way, the yellow, magenta, and cyan image data are printed on the recording sheet Pa one after another. Upon completion of printing of the cyan image data, the thermal head pressing solenoid **411** is deenergized, and the thermal head **410** is slid to the standby position. Thereafter, the DC servo motor is driven in the j-direction, thereby the recording sheet Pa having the color image printed thereon is fed back toward the inlet **21** and consequently discharged.

(2) Monochromatic printing on a precut recording sheet

Monochromatic printing on a precut recording sheet is executed similarly to the color printing on the precut recording sheet. When the image is printed in black once, the recording sheet Pa discharged through the recording sheet inlet **21**.

(3) Printing by means of hand scanning

Printing by means of hand scanning is executed as follows. Firstly, the printer case **2** is detached from the camera main body **1**. The thermal head **410** is pressed against a recording sheet Pa. The printing can be executed by moving the camera main body **1** in a direction indicated by an arrow k in FIG. **15** with an unillustrated print switch for hand scanning turned on. When the camera main body **1** is moved in the k-direction, the nip rollers **412** are rotated in the g-direction. The rotation of the nip rollers **412** is detected by the rotation sensor **413**. In accordance with the sensor signal sent from the rotation sensor **413**, a print timing and a printing speed of the thermal head **410** are controlled. Lines of the image data are printed on the recording sheet Pa in synchronism with the rotation speed of the nip rollers **412**, i.e., the sheet feeding speed.

In the case where the melt-out type ink ribbon is used, a plain precut paper sheet can be used as a recording sheet Pa. In this case, for instance, a recording sheet inlet in the form of a slit extending in a vertical direction in the plane of FIG. **17**, opening sideways and upward, and having a depth of L can be provided between the camera main body and the printer case **2** for inserting the recording sheet Pa therethrough as shown in FIG. **17**. Provision of the above inlet enables a photographed image to be printed freely on not only a special recording sheet of a specified size, but also an end portion of a plain recording paper sheet of a desired size. This facilitates confirmation and recording of the photographed image. Further, costs on the recording sheets Pa can be reduced. It should be noted that the position of the slit-like recording sheet inlet is not limited to the foregoing one. The inlet may be provided at any desired end portion of the camera main body **1**.

FIG. **18** is a circuit diagram of the thermal head **410**.

The thermal head **410** comprises an output control unit **500**, a head driver **504**, a heater unit **505**, and a thermistor **506**. The output control unit **500** is adapted for controlling a serial output of print signals. The head driver **504** is adapted for controlling a print timing of the thermal head **410**. The heater **505** comprises heating resistors R1 to R496 corresponding to respective print dots. The thermistor **506** is adapted for detecting a heating temperature of the thermal head **410**.

The output control unit **500** includes shift registers **501**, **502**, each of which is constituted of **248** D-flip-flops (hereinafter referred to as DFF) connected serially, and a latch circuit **503** for latching each of **496** print signals. The print signals are serially inputted to D-input ports provided in leading DFFs of the respective shift registers **501**, **502**. The print signals are sequentially outputted through Q-output ports of the respective DFFs of the shift register **501** to odd-numbered latch sections in the latch circuit **503** and the D-input ports of the next DFFs. On the contrary, the print signals are sequentially outputted through Q-output ports of the respective DFFs of the shift register **502** to even-numbered latch sections in the latch circuit **503** and the D-input ports of the next DFFs. Further, CLOCK signals are inputted to CK-input ports provided in the DFFs of the shift register **501**. On the contrary, inverted CLOCK signals inverted by an inverter **507** are inputted to CK-input ports provided the DFFs of the shift register **502**.

To the respective leading DFFs of the shift registers **501**, **502** are serially inputted the **496** print signals. Odd-numbered print signals are sequentially outputted from the respective DFFs of the shift register **501** to the corresponding latch sections in the latch circuit **503** upon the rise of the CLOCK signal. Even-numbered print signals are sequentially outputted form the respective DFFs of the shift register **502** to the corresponding latch sections in the latch circuit **503** upon the rise of the inverted CLOCK signal. At the moment when all the print signals are outputted to the latch circuit **503**, a latch signal is sent to the latch circuit **503**, whereby print signals of one line is latched.

FIGS. **19** and **20** are time charts respectively showing an operation of the output control unit **500**. FIG. **19** shows an operation of the output control unit **500** in a case that a printing operation is executed using the melt-out type ink ribbon and recording sheets (melting transfer mode), or by means of hand scanning (hand scanning mode). FIG. **20** shows an operation of the output control unit **500** in a case that the printing operation is executed using the sublimation type ink ribbon and recording sheets (sublimation transfer mode), or thermal type recording sheets (thermo-sensitive mode).

In the melting transfer or the hand scanning mode, an area gradation method is executed with the use of 4 dot-data (2 dots×2 dots). Accordingly, one line of the print data consists of 496 print signals, which are outputted to the latch circuit **503** in synchronism with the CLOCK signals and the inverted CLOCK signals. On the other hand, in the sublimation or the thermo-sensitive mode, an intensity modulation method is executed by modulating the printing energy with treating 4 dot-data (2 dots×2 dots) as one unit. Accordingly, in one line of the print data, the nth print signal and the (n+1)th print signal (where n is an odd integer between 1 and 456) become identical to each other. In other words, the DFFs of the shift register **502** outputs the print signals identical to those outputted from the DFFs of the shift register **501** located right above in FIG. **18**. In the time chart, 248 print signals are outputted to the latch circuit **503** in synchronism with the CLOCK signal as shown in FIG. **20**.

Table-2 below shows the number of pixels, a dot density, and an image size in each of the sublimation transfer mode and the melting transfer mode.

TABLE 2

	Sublimation Mode	Melt-Out Mode
Number of Pixels	494 × 768	494 × 768
Dot Density	8 dot/mm	16 dot/mm
Image Size	62. 8 × 97 .6 mm	62.8 × 97.6 mm

The difference between the sublimation transfer mode and the melting transfer mode is that the dot density in the sublimation transfer mode is half the dot density in the melting transfer mode, which is based on the difference in the aforementioned gradation method. The number of pixels and the image size are respectively same in the sublimation transfer mode and the melting transfer mode. The number of pixels is about 370,000, and the image size is of a credit card size.

Contrary to the fact that the thermal head **410** comprises 496 heating resistors, it will be seen from Table-2 that the print data of the :photographed image for one line consists of 494 print signals, lacking two print signals. When the print signals are inputted to the latch circuit **503** in the output control unit **500**, the two lacking print signals are representative of data not to be printed, e.g. "**00**."

Referring back to FIG. **18**, the head driver **504** includes 496 NAND circuits, to which the print signals are inputted from the latch sections in the latch circuit **503**. The **496** NAND circuits are divided into 8 blocks, each block having 62 NAND circuits. The 1st to 62nd NAND circuits constitute a first block, the 63rd to 124th NAND circuits constitute a second block . . . and the 435th to 496th NAND circuits constitute an eighth block. A control signal **STB1** is sent to the respective NAND circuits in the first block, a control signal **STB2** is sent to the respective NAND circuits in the second block, . . . and a control signal **STB8** is sent to the respective NAND circuits in the eighth block. Output ends of the respective NAND circuits are connected to one ends of the corresponding heating resistors Ri (where i is an integer between 1 and 496). The other ends of the heating resistors Ri are always connected to a common terminal to which a drive voltage, for example 24V, is applied.

In the above construction, when the high control signal **STB1** is inputted to the respective NAND circuits of the first block, the NAND circuits execute their arithmetic processing using the control signal **STB1** and the print signals and determine the level of output terminals thereof. In the case where the low level control signal **STB1** is inputted to the NAND circuits, the level of the output terminals of all the NAND circuits becomes high. On the other hand, in the case where the high level control signal **STB1** is inputted to the NAND circuits, the level of the output terminals of the NAND circuits to which the high level print signals are sent becomes low. Accordingly, only the heating resistors Ri connected to the output terminals of the NAND circuits in the low level are heated, so that the dots corresponding to the heated resistors Ri are printed on the recording sheet Pa. Similarly, when the control signals **STB2** to **STB8** are inputted to their corresponding NAND circuits, the respective NAND circuits of the second to the eighth blocks operate likewise. In this way, the image data are printed by the block.

FIG. **21** shows a timing chart of the control signals **STB1** to **STB8**. The control signal **STB1** to **STB8** are sent to the NAND circuits of the respective blocks with time-divided, i.e., by using successive time intervals for the different control signals. The data represented by 62 print signals is printed at one time. In this case, heating periods of the

respective heating resistors Ri of the heater unit **505** are controlled according to pulse durations T1 to T8 of the control signals STB1 to STB8. The pulse durations T1 to T8 determine the printing energy. The amount of printing energy is proportional to the heating temperature of the thermal head **410**. In view of this, the temperature of the thermal head **410** is monitored by the thermistor **506**, whereby the aforementioned pulse durations are controlled according to a temperature change of the thermal head **410** to maintain the printing energy at an appropriate level. More specifically, the pulse durations T1 to T8 of the control signals STB1 to STB8 are shortened upon a temperature rise while being lengthened upon a temperature drop.

Gradation is not controlled according to the amount of the printing energy in the melting transfer or the hand scanning mode, whereas it is so controlled in the sublimation or the thermo-sensitive mode.

In an n-step shade gradation control in the sublimation or the thermo-sensitive mode, the data corresponding to each dot is converted into a gradation level. The data can be completely printed by printing the data the number of times according to the gradation level using the control signal having a predetermined pulse duration. More specifically, the data for one line is converted into the data for n sublines based on the gradation level of the respective dots. For instance, the dot corresponding the data having a k-gradation level is so converted that the data for the first to the kth sub-lines are to be printed while those for the (k+1)th to nth sub-lines are not to be printed. In the same line, the data is printed using the control signals STB1 to STB8 having a pulse duration corresponding to the printing energy for one gradation level. Accordingly, the printing operation is repeated n times in the same line. However, the dot corresponding to the respective data are printed the number of times according to the gradation levels of the data. For example, the dots corresponding to the data having the k-gradation level is printed k times. Therefore, the data can be printed according to its gradation level.

Next, there will be described an operation of the camera with reference to flow charts shown in FIGS. **22**A to **26**E. Firstly, a main routine will be described with reference to FIGS. **22**A, **22**B.

When the main battery EB is mounted on the camera main body **1**, contents of various flags, registers. etc. are initialized in Step **#5**, and thereafter the main routine of the camera is executed.

Firstly, the CPU **100** sends the control signal Dcon in the form of "00" to the PC/PC converter **200**, whereby the DC/DC converter **200** stops its operation in Step **#10**. Subsequently, if the main capacitor C of the flash device **108** is being charged, the charging is stopped in Step **#15**. It is then discriminated whether the switch Srec is in the ON state in Step **#20**. If the switch Srec is in the OFF state, i.e., the operation mode is other than the "RECORD" mode (NO in Step **#20**), it is further discriminated whether the switch Soff is in the ON state in Step **#25**. If the switch Soff is in the OFF state, i.e., the camera is in an operative state, (NO in Step **#25**), the main routine proceeds to a "REPRODUCTION ROUTINE" to be described below. On the other hand, when the switch Soff is in the ON state (YES in Step **#25**), the type of the taking lens **3** in use is discriminated in Step **#30**. If the standard taking lens is set (NO in the Step **#30**), the main routine returns to Step **#5**. On the other hand, when the macro lens is set as one of the taking lens **3** (YES in Step **#30**), the macro lens is removed out of the optical axis, whereby the taking lens **3** becomes the standard one. Then, the main routine returns to Step **#5** in which the camera is brought into an inoperative state.

If, on the other hand, the switch Srec is in the ON state in Step **#20**, i.e., the operation mode is the "RECORD" mode, the main routine proceeds to Step **#40** in which it is discriminated whether the state of the switch Srec has been just changed to ON from OFF. If the state of the switch Srec has been just changed to ON from OFF (YES in Step **#40**), a flag FCHG is set to "1" (Step **#45**) so as to cause the capacitor C to be charged with electric energy. Then, the main routine proceeds to Step **#50**. On the other hand, if the switch Srec has been kept in the ON state (NO in Step **#40**), the main routine skips to Step **#50**. Subsequently, it is discriminated whether the switch Scard is in the ON state in Step **#50**. If the switch Scard is in the OFF state, i.e., the memory card **112** is not mounted yet (NO in Step **#50**), a flag FIC is reset to "0" in Step **#55** and the main routine proceeds to Step **#85**. The flag FIC indicates whether or not the memory card **112** is mounted on the camera main body **1**. If the flag FIC is reset to "0," it means that the memory card **112** is not mounted. On the contrary, if the flag FIC is set to "1." it means that the memory card **112** is mounted.

If the switch Scard is in the ON state (YES in Step **#50**), the main routine proceeds to Step **#60** in which it is discriminated whether the state of the switch Scard has just changed to ON from OFF. If the state of the switch Scard has just changed to ON from OFF (YES in Step **#60**), the flag FIC is reset to "0." On the other hand, if the switch Scard has been kept in ON (NO in Step **#60**), the main routine skips to Step **#70** in which the state of the flag FIC is discriminated. If the flag FIC is set to "1" (NO in Step **#70**), the main routine proceeds to Step **#85**. On the contrary, if the flag FIC is set to "0" (YES in Step **#70**), the main routine proceeds to Step **#75** in which the flag FIC is reset to "1." Then, in Step **#80**, administrative information or the like for stored data is read out of the memory card **112** into the CPU **100**, and the main routine proceeds to Step **#85**. Subsequently, in Step **#85**, it is discriminated whether all the image data stored in the memory card **112** are protected. If not all the image data are protected (NO in Step **#85**), the photographing operation is enabled and it is discriminated whether the switch S1 is in the ON state in Step **#90**. If the switch S1 is in the OFF state (NO in Step **#90**), the main routine proceeds to Step **#100**. On the contrary, if the switch S1 is in the ON state (YES in Step **#90**), it is further discriminated whether the state of the switch S1 has been just changed to ON from OFF in Step **#95**. If the state of the switch S1 has been just changed to ON from OFF (YES in Step **#95**), the main routine proceeds to a "S1 ROUTINE" to be described below so as to be ready for the photographing operation. If the switch S1 has been kept in the ON state (NO in Step **#95**), the main routine proceeds to Step **#100**. If all the image data are protected (YES in Step **#85**), the main routine proceeds to Step **#100**.

In Steps **#100** to **#125**, it is discriminated whether the switches Smode, Sfl, Smono, Smac, Spro, and Sadj are in the ON state respectively. If any of these switches are in the ON state, the mode is changed to another mode selected by this switch or the value is set to another value specified by this switch. More specifically, if the switch Smode is in the ON state (YES in Step **#100**), the current photographing mode is changed to the selected photographing mode in Step **#130**. If the switch Sfl is in the ON state (YES in Step **#105**), the current flash mode is changed to the selected flash mode in Step **#135**. If the switch Smono is in the ON state (YES in Step **#110**), the binary photographing mode is selected in Step **#140**. If the switch Smac is in the ON state (YES in Step **#115**), the macro photographing mode is selected, whereby the macro lens is placed on the optical axis in

addition to the taking lens 3 in Step #145. If the switch Spro is in the ON state (YES in Step #120), the stored images are protected in Step #150. If the switch Sadj is in the ON state (YES in Step #125), the date is renewed. The main routine returns to Step #10 from Steps 130, #135, #140, #145, #150, and #155.

If, on the other hand, all the switches are in the OFF state in Steps #100 to #125, the main routine proceeds to Step #160 in which it is discriminated whether the flag FCHG is set to "1." If the flag FCHG is set to "0" (NO in Step 160), it means that the flash mode is in the "OFF" mode. Accordingly, the main routine immediately returns to Step 10. If the flag FCHG is set to "1" (YES in Step #160), it is further discriminated whether charging of the main capacitor C has been completed in Step #165. If the charging has been completed (YES in Step #165), the main routine returns to Step #10. On the contrary, if the charging has not been completed yet (NO in Step #165), the main routine proceeds to step 175 in which the charging of the main capacitor C is started, and then the main routine returns to Step #10.

Next, there will be described the "S1 ROUTINE" with reference to FIG. 23A and 23B.

When the switch S1 is turned on, the charging is stopped if the main capacitor C is being charged in Step #180. Then, in Step #185, the battery check is executed. Subsequently, it is checked whether the main battery EB has sufficient energy source in Step #190. If the main battery EB has insufficient energy source (NO in Step #190), a warning is displayed on the indicator 17 in Step #195, and then the photographing operation is stopped. If, on the other hand, the main battery EB has sufficient energy source (YES in Step #190), the CPU 100 sends the control signal Dcon in the form of "00" to the DC/DC converter 200 so as to cause the DC/DC converter 200 to stop its operation (Step #200). In Step #205, the distance to the object is measured in the distance measuring unit 104. Subsequently, the luminance of the object is measured in the light measuring unit 105 in Step #210. In Step #215, it is discriminated whether the luminance of the object is low based on the measured object luminance. If the luminance of the object is low (YES in Step #215), the routine proceeds to Step #225 in which it is further discriminated whether the flash mode is set to the "OFF" mode. If the flash mode is set to the "OFF" mode, the routine proceeds to Step #260. If, on the other hand, the flash mode is set to the "AUTO" mode, or "FORCIBLE ON" mode (NO in Step #225), it is discriminated whether the main capacitor C has been charged with sufficient electric energy in Step #230 so as to confirm that flashes of light can be emitted to illuminate the object. If the main capacitor C has not been charged with sufficient electric energy (NO in Step #230), the charging of the main capacitor C is started in Step #240. Then, in Steps #245 and #250, it is discriminated whether the switches Srec and S1 are in the ON state respectively. If either of the switch Srec or S1 is in the OFF state, preparatory operation for the photographing operation is stopped, and the routine returns to Step #10 of the main routine. On the contrary, if both switches Srec and S1 is in the ON state, the routine returns to Step #230. The routine recycles Steps #240 to #250 (a charging loop) until the main capacitor C is charged with sufficient electric energy. Then, the routine proceeds to Step #235 in which the charging of the main capacitor C is stopped. Here, it will be noted that the charging of the main capacitor C is not required to be stopped in the case where the routine proceeds to Step #235 without going through Steps #240 to #250, and therefore the routine proceeds directly to Step #260.

If the luminance of the object is not low (NO in Step #215), it is discriminated in Step #220 whether the flash mode is set to the "FORCIBLE ON" mode. If the flash mode is not set to the "FORCIBLE ON" mode (NO in Step #220), the routine proceeds to Step #260. If the flash mode is set to the "FORCIBLE ON" mode (YES in Step #220), the routine proceeds to Step #230 in which the aforementioned charging operation is executed (Steps #230, 240 to 250).

In Step #260, it is discriminated whether the switch S2 is in the ON state. If the switch S2 is in the ON state (YES in Step #260), it is further discriminated whether the photographing mode is set to the "SELF-TIMER" mode in Step #265. If the photographing mode is set to the "SELF-TIMER" mode (YES in Step #265), a known control for the "SELFTIMER" mode is performed in Step #267. If the photographing mode is not set to the "SELF-TIMER" mode (NO in Step #265), the CPU 100 sends the control signal Dcon in the form of "10" to the DC/DC converter 200 in Step #270, whereby the DC/DC converter 200 supplies power to the image forming section 202 and the camera section 203 to activate them. Subsequently, the routine proceeds to Step #280 in which an exposure control is executed.

The exposure control is executed in accordance with a "EXPOSURE ROUTINE" shown in FIG. 24. It is first discriminated whether the flag FIC is set to "1" in Step #281. If the flag FIC is set to "1" (YES in Step #281), the memory card 112 is selected as storage medium in Step #282. If, on the other hand, the flag FIC is set to "0" (NO in Step #281), the built-in memories 311, 312 are selected as storage medium. The routine proceeds from Steps #282, #283 to Step #284 in which the object image is picked up by the CCD 101 to be converted into an image signal. The image signal is sent to the signal processing unit 102 where the aforementioned predetermined processings are applied to the image signal, and then stored in the selected storage medium in Step #285. Consequently, a frame number displayed on the indicator 17 is renewed, i.e., incremented by one in Step #286.

Referring back to FIG. 23B, upon completion of the exposure control, the routine proceeds to Step #290 in which the CPU 100 sends the control signal in the form of "00" to the DC/DC converter 200, causing the DC/DC converter 200 to stop its operation. Subsequently, it is discriminated whether the photographing mode is set to the "CONTINUOUS" mode in Step #301. If the photographing mode is not set to the "CONTINUOUS" mode (NO in Step #310), the routine returns to Step #10 of the main routine. On the other hand, if the photographing mode is set to the "CONTINUOUS" mode (YES in Step #310), the routine returns to Step #185 so as to be ready for the next photographing operation.

If the switch S2 is in the OFF state in Step #260, the routine proceeds to Step #295 in which it is discriminated whether the photographing mode is set to the "CONTINUOUS" mode. If the photographing mode is set to the "CONTINUOUS" mode (YES in Step #295), the routine returns to Step #10 of the main routine. If, on the other hand, the photographing mode is not set to the "CONTINUOUS" mode (NO in Step #295), it is discriminated whether the switches Srec and S1 are in the ON state respectively in Steps #300 and 305. If either of the switch Srec or S1 is in the OFF state (NO in Step #300 or 305), the preparatory operation for the photographing operation is stopped and the routine returns to Step #10. If both the switches Srec and S1 are in the ON state (YES in Steps #300 and 305), the routine returns to Step #260.

Next, there will be described "REPRODUCTION ROUTINE" with reference to FIG. 25A and 25B.

Upon setting operation mode to the "REPRODUCTION" mode, the charging is stopped in Step #400 in the case where the main capacitor C is being charged. Then, the routine proceeds to Step #405 in which flags FIC, FRBN are both set to "0." The flag FRBN indicates whether the ink ribbon 416 is set properly for a next printing operation with the leading end of a next ribbon segment being set in a specified position. If the flag FRBN is set to "1," it means that the next ribbon segment is set in the specified position for the next printing operation. If, on the contrary, the flag FRBN is set to "0," it means that the ink ribbon 416 should be fed until the next ribbon segment is set in the specified position in order to execute the next printing operation.

Thereafter, the routine proceeds to Step #410 in which it is discriminated whether the switch Srep or Spri is in the ON state. If neither of these switches is in the ON state, i.e., the reproduction and printing operation are prohibited, the routine returns to Step #10 of the main routine. If at least either of the switch Step or Spri is in the ON state (YES in 410), it is further discriminated whether the switch Scard is in the ON state in Step #415. If the switch Scard is in the OFF state (NO in Step #415), i.e., the memory card 112 is not mounted to the camera main body 1, the flag FIC is reset to "0" in Step #420, and the routine proceeds to 450. On the other hand, if the switch Scard is in the ON state (YES in Step #415), it is further discriminated whether the state of the switch Scard has been just changed to ON from OFF in Step #425. If the state of the switch Scard has been just changed to ON from OFF (YES in Step #425), the flag FIC is reset to "0" in Step #430. If, on the other hand, the state of the switch Scard has been kept in the ON state (NO in Step #425), the routine skips to Step #435. In Step #435, the state of the flag FIC is discriminated. If the flag FIC is set to "1" (NO in Step #435), the routine proceeds to Step #450. If the flag FIC is set to "0" (YES in Step #435), the flag FIC is set to "1" in Step #440. Subsequently, the administrative data or the like for the data stored in the memory card 112 is transferred therefrom to the CPU 100 in Step #445, and then the routine proceeds to Step #450. In Step #450, it is discriminated whether there is any image data stored in the memories. If there is no image data stored in the memories (NO in Step #450), an indication "NO IMAGE STORED" is displayed on the indicator 17 in Step #455, and the routine returns to Step #410.

On the other hand, if there is any image data stored in the memories (YES in Step #450), it is discriminated whether the switch Sup or Sdown is in the ON state in Step #460. If both switches Sup and Sdown are in the OFF state (NO in Step #460), the routine proceeds to Step #485. On the other hand, if either of the switch Sup or Sdown is in the ON state (YES in Step #460), it is discriminated whether the state of the switch has just changed from OFF to ON in Step #465. Unless the switch Sup or Sdown has been kept in the ON state (NO in Step #465), the routine proceeds to Step #485. If the state of switch Sup or Sdown has just changed from OFF to ON (YES in Step #465), it is discriminated which of the switch Sup or Sdown is in the ON state in Step #470. If the switch Sup is in the ON state (YES in Step #470), the succeeding image data is accessed in Step #475 and the routine returns to Step #410. If the switch Sdown is in the ON state (NO in Step #470), the preceding image data is accessed in Step #480 and the routine returns to Step #410.

In Step #485, it is discriminated whether the switch Smal is in the ON state. If the switch Smal is in the ON state (YES in 485), an indication "MULTI-DISPLAY" is displayed on the indicator 17 in Step #490. On the other hand, if the switch Smal is in the OFF state (NO in Step #485), the indication "MULTI-DISPLAY" is not displayed on the indicator 17 in Step #495. In Step #500, the current frame number is displayed on the indicator 17. Subsequently, it is discriminated whether the switch Spro is in the ON state in Step #505. If the switch Spro is in the ON state (YES in Step #505), the stored images are protected in Step #510. If the switch Spro is in the OFF state (NO in Step #505), protection of the stored images is released in Step #512. Subsequently, it is discriminated whether the switch Srep is in the ON state in Step #515. If the switch Srep is in the ON state (YES in Step #515), the stored images are processed for TV reproduction in Step #520. On the other hand, if the switch Srep is in the OFF state (NO in Step #515), the stored images are printed out in Step #525. Consequently, the routine returns to Step #410.

Next, there will be described "PRINT ROUTINE" with reference to FIGS. 26A, 26B. 26C, 26D, and 26E.

Upon setting operation mode to the "PRINT" mode, it is first discriminated whether the ink ribbon 416 is set in Step #530. If the ink ribbon 416 is not set (NO in Step #530), it is determined that the thermo-sensitive mode is to be set, and the same mode is recorded in Step #535. Then, the routine proceeds to Step #600.

If the ink ribbon is set (YES in Step #530), it is discriminated whether both leading end sensors A 417 and B 418 have detected black portions of the ink ribbon 416 in Step #540. If both the leading end sensors A 417, B 418 have detected the black portions of the ink ribbon 416 (YES in Step #540), it is determined that the hand scanning mode is recorded as a print mode, whereby the printing operation is executed by means of hand scanning as will be described hereinafter. If, on the other hand, not both the leading end sensors A 417, B 418 have detected the black portions of the ink ribbon 416 (NO in Step #540), it is discriminated in Step #545 whether the flag FRBN is reset to "0." If the flag FRBN is set to "1" (NO in Step #545), it is determined that the next ribbon segment is set in the specified position for the next printing operation, and the routine proceeds to Step #580. If the flag FRBN is reset to "0" (YES in Step #545), it is determined that the ink ribbon 416 should be fed until the next ribbon segment is set in the specified position for the next printing operation. Subsequently, the DC servo motor 420 is drivingly rotated in the j-direction (see FIG. 8), whereby the ink ribbon 416 starts being taken up in Step #550. In other words, the leading end of the next ribbon segment is fed to a predetermined position for the next printing operation. Subsequently, it is discriminated whether the sensor A 417 has detected the black marker m in Step #555. If the sensor A 417 has detected no black marker m (NO in Step #555), it is further discriminated whether the sensor B 418 has detected the black marker m in Step #565. If the sensor B 418 has detected no black marker m (NO in Step #565), i.e., neither the sensors A 417 nor B 418 has detected the black marker m, a detecting operation is executed to detect the black marker m for a predetermined period of time, which is set by an unillustrated timer (a loop of Steps #555, #565, and #585). When the predetermined period of time is up (YES in Step #585), the DC servo motor 420 is caused to stop its operation, whereby the ink ribbon 416 stops being taken up in Step #590. Consequently, an indication "INK RIBBON ERROR" is displayed on the indicator 17 in Step #595.

If, on the other hand, the sensor A 417 has detected the black marker m (YES in Step #555), it is determined that the melting transfer mode is to be set and the same mode is recorded in Step #560. Further, if the sensor B 418 has detected the black marker m (YES in Step #565), it is determined that the sublimation transfer mode is to be set

and the same mode is recorded in Step #570, and the routine proceeds to Step #575 in which the flag FRBN is set to "1." Subsequently, the ink ribbon 416 is stopped being taken up in Step #580, and the routine proceeds to Step #600. In Step #600, it is discriminated whether the switch S2 is in the ON state. If the switch S2 is in the OFF state (NO in Step #600), the routine returns to Step #410. If the switch S2 is in the ON state (YES in Step #600), the type of the recording sheet Pa is detected by the recording sheet sensors A 414, B 415. More specifically, presence or absence of the recording sheet Pa is discriminated in Step #605. The presence or absence of the recording sheet Pa is detected by means of the recording sheet sensors A 414, B 415. If both the sensors A 414 and B 415 have detected the black, the absence of the recording sheet Pa is detected. In other cases, the presence of the recording sheet Pa is detected. If the absence of the recording sheet Pa is detected, the routine returns to Step #410. On the other hand, if the presence of the recording sheet Pa is detected, the routine proceeds to Step #610 in which it is discriminated whether the sensor A 414 has detected the black marker M. If the sensor A 414 has detected the black marker M (YES in Step #610), it is further discriminated in Step #615 whether the sublimation transfer mode is currently set as a print mode. If the sublimation transfer mode is currently set as a print mode (YES in Step #615), the routine proceeds to Step #650. If the sublimation transfer mode is not currently set as a print mode (NO in Step #615), an indication "MEDIA MISMATCH ERROR" is displayed on the indicator 17 in Step #635 since the recording sheet Pa is not in agreement with the set ink ribbon 416. The indication "MEDIA MISMATCH ERROR" is kept displaying on the indicator 17 until both the sensors A 414, B 415 detect the black, i.e., the absence of the recording sheet Pa is detected in Step #640 (a loop of Steps #635, 640). At the point when the absence of the recording sheet Pa is detected (YES in Step #640), the indication "MEDIA MISMATCH ERROR" is lighted off in Step #645. Consequently, the routine returns to Step #410.

If the sensor A 414 has detected no black marker M (NO in Step #610), it is further discriminated that the sensor B 415 has detected the black marker M in Step #620. If the sensor B 415 has detected the black marker M (YES in Step 620), it is further discriminated whether the thermo-sensitive mode is currently set as a print mode in Step #625. If the thermo-sensitive mode is currently set as a print mode (YES in Step #625), the routine proceeds to Step #650. If, on the other hand, the thermo-sensitive mode is not currently set as a print mode (NO in Step #625), the routine proceeds to the aforementioned loop of Steps #635, #640 in which the indication "MEDIA MISMATCH ERROR" is displayed on the indicator 17 until the absence of the recording paper Pa is detected, and then the routine returns to Step #410.

If the sensor B 415 has detected no black marker M (NO in Step #620), i.e., neither the sensor A 414 nor B 415 detects the black marker M, it is discriminated whether the melting transfer mode is currently set as a print mode in Step #630. If the melting transfer mode is currently set as a print mode (YES in Step #630), the routine proceeds to Step #650. If the melting transfer mode is not currently set as a print mode (NO in Step #630), the routine proceeds to the aforementioned loop of Steps #635, #640 in which the indication "MEDIA MISMATCH ERROR" is displayed on the indicator 17 until the absence of the recording paper Pa is detected, and then the routine returns to Step #410.

In Step #655, it is checked whether the main battery EB has sufficient energy source. If the main battery EB has insufficient energy source (NO in Step #655), a warning is displayed on the indicator 17, and consequently the printing operation is stopped in Step #660. If the main battery EB has sufficient energy source (YES in Step #655), the DC servo motor 420 is actuated to feed the recording sheet Pa in a sheet insertion direction (the b-direction in FIG. 7) by a predetermined distance (run distance) in Step #665. Subsequently, it is checked whether the thermo-sensitive mode is currently set as a print mode in Step #670. If the thermo-sensitive mode is not currently set as a print mode (NO in Step #670), a value 3 is set in a color counter in Step #675. The value 3 indicates the number of the printing operation to be executed. If the thermo-sensitive mode is currently set as a print mode (YES in Step #670), a value 1 is set in the color counter in Step #680. Then, the thermal head 410 is pressed against the recording sheet Pa with the ink ribbon 416 therebetween in Step #685. Subsequently, the DC servo motor 420 is actuated in the j-direction so as to feed the recording sheet Pa toward the sheet inlet 21 by a predetermined distance (runback distance) in Step #690. In Step #695, all the lines (768 lines) constituting one frame of image are set, and the CPU 100 sends the control signal Dcon in the form of "11" to the PC/PC converter 200 in Step #700, whereby the power is supplied to the printer section 111 and the camera section 203. Subsequently, one line of the yellow image is printed. Each time one line of the yellow image is printed, the recording sheet Pa is fed toward the inlet 21 by one line. Printout of a complete yellow image is accomplished by alternately printing one line of the yellow image and feeding the recording sheet Pa by one line (a loop of Steps #700 to 710). Upon completion of printout of the complete yellow image (YES in Step #710), the CPU 100 sends the control signal Dcon in the form of "00" to the DC/DC converter 200 in Step #715, and thereby the PC/PC converter is caused to stop its operation. Then, the value set in the color counter (color counter value) is decremented by one in Step #720, and it is discriminated in Step #725 whether the color counter value is 0. If the color counter value is not 0 (NO in Step #725), the thermal head 410 is slid to the standby position in Step #730. Thereafter, the recording sheet Pa is fed in the sheet insertion direction (j-direction in FIG. 7) by a predetermined distance (run distance plus a distance equivalent to all the lines) in Step #735, and then an operation of Steps #685 to #725 is executed to print a complete image of a next color. When all the available color images are printed to reproduce a complete image, i.e., the color counter value becomes 0 (YES in Step #725), the recording sheet Pa is discharged through the inlet 21 in Step #740. After the thermal head 410 is slid to the standby position in Step #745, the flag FRBN is reset to "0" in Step #750, and the routine returns to Step #410.

If both the leading end sensors A 417, B 418 have detected the black portions of the ink ribbon 416 (YES in Step #540), it is determined that the hand scanning mode is to be set, and the same mode is recorded as a print mode in Step #755. Subsequently, it is discriminated whether the switch S2 is in the ON state in Step #760. If the switch S2 is in the OFF state (NO in Step #760), the routine returns to Step #410. On the other hand, if the switch S2 is in the ON state (YES in Step #760), it is checked whether the main battery EB has sufficient energy source in Step #770. If the main battery EB has insufficient energy source (NO in Step #770), a warning is displayed on the indicator 17, whereby the printing operation is stopped in Step #775. If the main battery EB has sufficient energy source (YES in Step #770), the DC servo motor 420 is actuated consequently to cause the nip rollers 412 to rotate (YES in Step #780). The rotation of the nip rollers 412 is detected by the rotation sensor 413, which in turn sends a corresponding sensor signal. In accordance with the sensor signal from the rotation sensor 413, the thermal head 410 is pressed against the recording sheet Pa in Step

#785. After all the lines (e.g., 768 lines) constituting one frame of image are set in Step #790, the CPU 100 sends the control signal Dcon in the form of "11" to the DC/DC converter 200, whereby the power is supplied to the printer section 111 and the camera section 203 in Step #795. Thereafter, a complete image is printed by alternately printing of one line of the image and feeding the recording sheet Pa in synchronism with the rotating speed of the nip rollers 412, i.e., the speed at which the recording sheet Pa is fed toward the insertion opening of the inlet 21. More specifically, upon the printer section 111 and the camera section 203 being actuated in Step #795, one line of the image is printed in Step #800. Subsequently, it is discriminated whether one frame of image has been printed in Step #805. If there still remain the lines to be printed (NO in Step #805), it is discriminated whether the nip rollers 412 have rotated such an amount as to feed the recording sheet Pa by one line in Step #810. Not having been rotated this amount, the nip rollers 412 are rotated a deficient amount, so that a next line of the image can be printed in a precise position. Then, the routine returns to Step #795. The operation of Steps #795 to #810 is repeated until one frame of image is printed. When one frame of image is completely printed (YES in Step #805), the CPU 100 sends the control signal Dcon in the form of "00" to the DC/DC converter 200 in Step #815, whereby the DC/DC converter 200 stops its operation. Then, the thermal head 410 is slid to the standby position in Step #820, and the routine returns to Step #410.

FIG. 27 is a perspective view showing a camera provided with a built-in printer embodying the invention as a second embodiment. In FIG. 27, elements identical to those shown in FIG. 3A are indicated by the same reference numerals. In this embodiment, a front face of a printer case 2 is not in line with a front face of a camera main body 1. Specifically, the front face of the printer case 2 is retracted from the front face of the camera main body 1, providing a gap therebetween. This gap provides on the side face of the camera main body bearing in contact with the side face of the printer case 2 a free surface area, which serves as a recording sheet insertion guide 21*a*. The recording sheet insertion guide 21*a* enables a precut recording sheet Pa to be inserted easily and accurately, thereby improving operability of the camera in terms of a printing operation. The sheet inlet 21*a* is provided on a forward portion of the camera main body 1. However, it should be noted that the sheet insertion guide 21*a* may be provided on a rearward portion of the camera main body 1.

Incidentally, in a camera provided with a built-in printer, the heat is generated as a result of a printing operation in a printer section 111. This heat adversely affects a CCD 101 or other elements provided in an image forming section 202. Accordingly, it is preferable to provide the printer section 111 and the image forming section 202 away from each other in the camera main body 1, so that the heat generated in the printer section 111 has no influence on the image forming section 202. FIGS. 28 to 30 are diagrams respectively showing arrangements of the printer section 111, a portion of the camera main body 1 into which the memory card 112 is mounted, and the image forming section 202.

In each of the three types of arrangements shown in FIGS. 28 to 30, the printer section 111 is provided in one lateral end portion of the camera main body 1 with respect to a lateral direction thereof, and the image forming section 202 is provided in the other lateral end portion of the camera main body 1. The memory card mounting portion is provided between the printer section 111 and the image forming section 202. The above three arrangements differ from one another only in the positions where a taking lens is provided in the other lateral end portion of the camera main body 1. By arranging the printer section 111, the memory card mounting portion, and the image forming section 202 as described above, the space within the camera main body can be effectively utilized. In addition, it can be prevented that the heat generated by the printer section 111 adversely affects the image forming section 202.

In the foregoing embodiments, the printer section 111 is incorporated into the camera main body 1. However, in consideration of the current trend toward a multi-functional camera, it may be appropriate that respective sections of the camera be formed into collectible units, and some or all of these units be combinedly used to form a camera suitable for applications.

FIGS. 31 to 34 show an embodiment in which respective sections are formed into collectible units. In those figures, elements identical to those shown in FIG. 3A are indicated by the same reference numerals. FIG. 31 shows a camera unit 22 comprising an image forming system including a taking lens 3, a viewfinder 4, a flash device 6, a main battery EB, and a memory card 112. On each of lateral end surfaces of the camera unit 22 is provided a connecting portion 22*a* for connecting the camera unit 22 with other units electrically and mechanically. FIG. 32 shows a TV reproduction unit 23 for processing image signals stored in a storage medium so as to be reproduced on TV. Also, the TV reproduction unit 23 has terminal 23*b* for connection with TV. FIG. 33 shows a display unit 24 for processing image signals stored in the storage medium so as to be reproduced on a monitor, and displaying the processed signals on a monitor 24*b* comprising liquid crystal display or the like. FIG. 34 shows a printer unit 25 having a printer provided integrally therein, and adapted for printing the stored image on a recording sheet. Also, the printer unit 25 has recording sheet storage portion 25*b*. Similarly to the camera unit 23, the TV reproduction unit 23, the display unit 24, and the printer 25 respectively have connecting portions 23*a*, 24*a*, 25*a* provided at opposite lateral end surfaces thereof for connecting one unit with other units electrically and mechanically. The above four units are connectable to one another.

FIGS. 35 to 37 show states in which the camera unit 22 is connected with the printer unit 25, the display unit 24, and the TV reproduction unit 23 respectively. FIG. 38 shows a state in which the camera unit 22 is connected with the display unit 24 and the printer unit 25. In FIG. 38, it may be appropriate that the printer unit 25 be first connected with the camera section, and the display unit 24 be connected to the printer unit 25. Alternatively, the display unit 24 and the printer unit 25 may be connected to the camera unit 22 at the opposite lateral end surfaces of the camera unit 22 respectively. Further, it is also possible to connect the TV reproduction unit 23 and the printer unit 25 with the camera unit 22 in a similar way.

In the construction shown in FIG. 38, when printing the stored images is the only operation to be executed, it is preferable to introduce the image signals from the camera unit 22 directly to the printer unit 25. In view of this, it may be advantageous to provide in the display unit 24 a signal line for introducing the image signals from the camera unit 22 into the display unit 24 and a junction line for introducing them directly into the printer unit 25. The signal line and the junction line may be controllably switched from one line to the other in accordance with a control signal from the CPU 100 in the camera unit 22. Alternatively, these lines may be so controlled as to switch from the signal line to the junction line each time the operation switch of the printer unit 25 is turned on.

Further, in the foregoing embodiments, a memory card for storing digital data is used as an external storage medium. However, a floppy disc for storing analog data, an optical disc, or an optical card may also be used as an external storage medium.

As described above, according to the present invention, in a camera provided with a built-in printer in which an ink ribbon can be removably mounted, a print mode by which image data transferred to the printer is printed is controllably set in accordance with presence or absence of the ink ribbon. Accordingly, the following two types of print modes can be automatically set: a thermal type print mode in which the ink ribbon is required and a heat transfer type print mode in which the ink ribbon is not required. Therefore, the stored images can be printed in both modes easily and readily.

Further, a print mode by which image data transferred to the printer is printed is controllably set in accordance with the type of the ink ribbon in use. Accordingly, the following two types of print modes can be automatically set: a sublimation print mode and a melting transfer print mode. Therefore, the stored images can be printed easily and readily according to an application in a desired print mode.

Although the present invention has been fully described by way of example with reference to the accompanying drawings, it is to be understood that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such change and modifications depart from the scope of the invention, they should be construed as being included therein.

What is claimed is:

1. A camera comprising:

a taking lens which permits light from an object to form an image of the object;

an image sensor which picks up the image formed by said taking lens; and

a printer which prints the picked-up image, said printer including structure for holding an internal recording paper, and having two selectable modes including:

a first mode in which the picked-up image is printed on the internal recording paper; and

a second mode in which the picked-up image is printed on an external recording paper provided outside of said camera.

2. A camera according to claim 3 further comprising a feeder which feeds the internal recording paper, said feeder being in operation in said first mode and not being in operation in said second mode.

3. A camera according to claim 2, wherein said printer includes a print head which is, in said second mode, exposed to the outside of said camera to come into contact with the external recording paper.

4. A camera according to claim 3, wherein said feeder is operable to cover said print head in said first mode.

5. A camera according to claim 3, wherein said camera is manually movable over the external recording paper, and said printer is operable to print the picked-up image on the external recording paper during the manual movement of said camera in said second

6. A camera according to claim 5, further comprising:

a sensor which detects the manual movement of said camera; and

a controller which is responsive to said sensor and controls the printing of said printer in accordance, with the manual movement.

7. A camera comprising:

a taking lens which permits light from an object to form an image of the object;

an image sensor which picks up the image formed by said taking lens;

a printer which prints the picked-up image, said printer including structure for holding an internal recording medium, and having two selectable modes including:

a first mode in which the picked-up image is printed on the internal recording medium; and

a second mode in which the picked-up image is printed on an external recording medium provided outside of said camera; and

a feeder which feeds the internal recording medium, said feeder being in operation in said first mode and not being in operation in said second mode.

8. A camera according to claim 7, wherein said printer includes a print head which is, in said second mode, exposed to the outside of said camera to come into contact with the external recording medium.

9. A camera according to claim 8, wherein said feeder is operable to cover said print head in said firsts mode.

10. A camera, comprising:

a taking lens which permits light from an object to form an image of the object;

an image sensor which picks up the image formed by said taking lens; and

a printer which prints the picked-up image, said printer including structure for holding an internal recording medium, and having two selectable modes including:

a first mode in which the picked-up image is printed on the internal recording medium; and

a second mode in which the picked-up image is printed on an external recording medium provided outside of said camera,

wherein said camera is manually movable over the external recording medium, and said printer is operable to print the picked-up image on the external recording medium during manual movement of said camera in said second mode.

11. A camera according to claim 10 further comprising:

a sensor which detects the manual movement of said camera; and

a controller responsive to said sensor which controls the printing of said printer in accordance with the manual movement.

12. A camera comprising:

a taking lens which permits light from an object to form an image of the object;

an image sensor which picks up the image formed by said taking lens;

a printer which prints the picked-up image on a recording paper, said printer including structure for holding an internal recording paper; and

a feeder which feeds the internal recording paper, said feeder having two selectable modes in a state in which the printer is placed in operation including:

a first mode of executing feeding of the internal recording paper to print; and

a second mode of suspending feeding of the internal recording paper to print.

13. A camera according to claim 12, wherein-said printer is operable to print the picked-up image on the internal

recording paper in said first mode and to print the picked-up image on an external recording paper which is outside said camera in said second mode.

14. A camera, comprising:

a taking lens which permits light from an object to form an image of the object;

an image sensor which picks up the image formed by said taking lens;

a printer which prints the picked-up image on a recording medium, said printer including structure for holding an internal recording medium; and

a feeder which feeds the internal recording medium, said feeder having two selectable modes in a state in which the printer is placed in operation including:

a first mode of executing feeding of the internal recording medium; and

a second mode of suspending feeding of the internal recording medium,

wherein said printer is operable to print the picked-up image on the internal recording medium in said first mode and to print the picked-up image on an external recording medium which is outside said camera in said second mode.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,493,409

DATED : February 20, 1996

INVENTOR(S) : Yutaka Maeda, et al.

It is certified that error appears in the above-indentified patent and that said Letters Patent is hereby corrected as shown below:

In col. 4, line 15, after "having" insert --a--.

In col. 5, line 14, delete "is a".

In col. 8, line 46, change "SF1" to --Sf1--

In col. 9, lines 25 and 29, change "PC/PC" to --DC/DC--.

In col. 10, line 43, after "in" insert --or--.

In col. 11, line 51, after "memory" insert --to--.

In col. 12, line 43, change "luminanee" to --luminance--.

In col. 13, line 13, after "TV" insert --or--.

In col. 16, line 41, after "perpendicular" insert --to--.

In col. 16, line 44, after "be" insert --a--.

In col. 18, line 32, after "Pa" insert --is--.

In col. 19, line 27, after "provided" insert --in--.

In col. 21, line 47, change "PC/PC" to --DC/DC--.

In col. 25, line 19, change "Step" to --Srep--.

In col. 28, lines 19 and 30, change "PC/PC" to --DC/DC--.

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,493,409

DATED : February 20, 1996

INVENTOR(S) : Yutaka Maeda, et al.

It is certified that error appears in the above-indentified patent and that said Letters Patent is hereby corrected as shown below:

In col. 31, line 45 (claim 2, line 1), change "claim 3" to --claim 1--.

In col. 31, line 56 (claim 5, line 1), change "claim 3" to --claim 1--.

In col. 31, line 60 (claim 5, line 5), after "second" insert --mode.--.

In col. 32, line 23 (claim 9, line 2), change "firsts" to --first--.

Signed and Sealed this

Twenty-fifth Day of June, 1996

Attest:

Bruce Lehman

BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks